THE

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THE

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EDUCATION BY OBSERVATION.

Two exceptionally interesting departmental addresses were delivered to the British Association at the recent Belfast meeting: one to the Engineering Section "G," by Prof. Perry, the other by Prof. Armstrong to the new section "L," which deals with Educational Science. Prof. Perry limits himself primarily to methods of training the young engineer, Prof. Armstrong treats of education in general. Both agree in essentials, though differing in detail; both exalt the imaginative or observing faculty of the youth, and both deprecate a mere stimulation of his assimilative power. Of Prof. Perry's views we have no need to give an outline, for in the main he has simply repeated his former description of the ideal educational system, elaborating his arguments, it is true, but reproducing in the attractive manner which is so characteristic of him the opinions contained in that admirable pamphlet, "England's Neglect of Science." We note a slight divergence between the two authors which is worthy of a moment's thought; Prof. Armstrong takes a higher view of the educational value of Latin than does Prof. Perry, while the latter ranks mathematics—his own practical mathematics—above the level granted to it by Prof. Armstrong. Both, as might be foreseen, insist on natural science as a necessary subject; while Prof. Perry seems inclined to accept an education from which all foreign languages are excluded.

This last notion is wildly heterodox, but there is much to be said for it. There is no advantage in a man becoming imperfectly polyglot; a slight acquaintance with one or more foreign languages is useless; a thorough working knowledge of one or more is useful, but it is questionable whether the time occupied in acquiring that knowledge might not more profitably be devoted to the subjects included in the schoolman's term "English": *i.e.*, the English language, the art of composition, British history, the geography of the British Empire, political economy, and perhaps a general understanding of the British "Constitution." With all respect to the national feelings of our friends on the Continent of Europe, the English language will become the language of the world for every purpose save that of pure literature; and therefore, it is less necessary for the Briton to study (say) German, than for the German to study English. It is curious to note that after the death of "Volapük" and its congeners—we believe these weird codes of words are dead—a suggestion has been made (by Sir F. Bramwell at the B.A.), to adopt Italian as an international language for science and commerce. In the Middle Ages, when only a limited number of persons could read and write, and when travelling was comparatively unknown, an esoteric medium of intercourse was possible and tolerable; but with universal education the notion becomes impossible, and the tongue which has already won for itself the widest acceptance, which has the largest vocabulary, and which is best able to absorb new expressions, is bound to come to the front.

Prof. Armstrong has taken the present opportunity of inventing a new and happy phrase; he has spoken of the "Four Rs.," the last being "Reasoning." It is natural to the child—the British child at all events, happily—to be interested in things rather than in words; he wants to see the wheels go round, but is not specially desirous of reading how they do so. Therefore, the function of the school should be to give him the wheels, and the teacher must help him to examine them; and while this is being done, numberless occasions arise for explaining theoretical points which become interesting and absorbing in the presence of the model, though dry, repellant, and unintelligible in its absence. In fact, the whole principle of education, of whatever kind, is contained in the sentence quoted by Prof. Armstrong from Oliver Wendell Holmes:—"I don't want you to believe anything I say, I only want you to try to see what makes me believe it."

And this quotation brings us to another point. Quite apart from the lessons it seeks to impart, Prof. Armstrong's address is a piece of charming English prose, as elegant as it is eloquent; and both it and Prof. Perry's paper are studded with quotations from the masters of English literature. Without desiring to be offensive, we wonder how many of our chemical and engineering students, or our successful chemists and engineers, could, without assistance, put names to these quotations, or could explain the allusions which abound in the address to Section G? Most of us have to earn our livings, and have to do so in the face of severe competition; a competence is only to be gained by deep and narrow specialisation and much routine work, which is dull and uninteresting. Apparently but little time and nervous energy are left for general culture, while literature and the fine arts must be wholly neglected. It is not true and not necessary; it is even fatal. Specialisation is undoubtedly requisite, but it should be postponed as long as possible; and before it is begun the training should include the most various subjects, so that ultimately the man shall become not a mere laboratory investigator engaged in collecting facts; but a man of science, able to collate those facts into theories and so-called laws; a man of the nation, able to bear his burden and wisely to enjoy his privileges as a British citizen; a man of the world, able and willing to add his mite to the evolution of the human race.

The Surface Contact Fad.

In the following pages will be found a full description of the Dolter surface contact system. We desire, however, to call attention to the fact that the article *is* a description, and not a criticism. We regret to say that our faith in the contact system—in any electrical contact system—is not robust.

In our issue of April 4th, 1902, was published an article dealing with the Lorain surface contact system as employed in Wolverhampton. That article was not aimed at the Lorain system in particular; in fact, we believe that as an electrical contact system that is almost as good as the best; it was directed mainly against the action of an unrepresentative body of men who had put their hands into the ratepayers' pockets, even, we may say, exacting from them signed blank cheques, in order to equip their 11 or 12 miles of track with a system, whose sole recommendation in practice was that it had been tried for some months in Washington, U.S.A., and then pulled up.

As we protested then, so we protest now, against the adoption by any corporate body, without an actual poll of the ratepayers, of an untried system, and a system the only conceivable advantage of which is that the trolley wire is eliminated. What are the objections to the trolley wire?—That it is carried on poles, and is unsightly! The objection has been proved groundless so often that we will not waste space in refuting it once more.—That it is dangerous! Such a serious objection calls for rigid proof, and we call on the objectors to state how many fatalities to human beings, how many severe shocks, how many injuries of any description, have been caused by the falling of a trolley wire in England. The trolley wire is put up too well to fall around as some people would have us believe, and we cannot recall a single fatality arising from the occasional accidents of that description which have occurred. All the accidents are due to telephone wires, or guard wires, falling across the live trolley wires, and dangling in the roadway; and, we would ask, is that any reason why a system, of which the first cost is known, of which the *depreciation* is known, of which the general reliability is known, should be superseded by a system of which hardly the first thing is known, and for which, whether for good or evil, the ratepayer has to pay? If it were not that the itching desire to do something out of the way, whether with one's own money or that of someone else—the desire to see oneself mentioned in the ha'penny papers as having invented a flying machine, or started a surface-contact system—had not gripped so many authorities fast, we would suggest that it would be far cheaper to make the trolley system perfectly safe by removing or insulating all crossing wires, thereby automatically removing the offensive guard-wire, than to plunge headlong into the unknown. We say "the unknown" wittingly, for although the Lorain system (the only contact system in England at the present moment) has been working for several months, it has not been working nearly long enough to give any kind of notion, even to the officials, as to its worth and its cost. Not for three years at least can true working results be expected; and for that reason we dread the issue of the first year's accounts of the Wolverhampton Tramways. They will be phenomenally good; they will be flaunted in the face of everyone who has said a doubting word; they will be used as only municipal special pleaders know how to use such flawed goods; and the pity of it, they will be the means of turning the already observed hankering after a contact system of some kind or another into a boom. And booms are dreadful things to contemplate.

The news that two more towns have adopted *two more* contact systems is ominous, and we would implore those towns that are thinking, or that are about to think, of adopting one of these, or one of the many others in existence on paper and on trial tracks, to pause again before they leap; to take still further advice; even to postpone erecting any system whatever, until scientifically reliable results and figures have been obtained from the one system in operation, and the two that are to be put down. That Torquay and Swansea are not confident of the success of the Lorain system after examining it while working, is well proved by their selecting other systems; but, the wise man will ask, how much better off are they, for Wolverhampton had the choice of these two systems, and accepted another?

Brentwood.—By 35 votes to 4, a ratepayers' meeting on Friday decided that the U.D.C. should apply for a prov. order to supply current for light and power in the district. We may add that the population of this district is 4,932. Such is the interest manifested by the burgesses in their own doings.

The representatives of the adjoining districts have pledged themselves to support the U.D.C.'s electric light scheme in their own parishes.

PROF. DEWAR AND THE BRITISH ASSOCIATION.

The very lengthy Presidential Address delivered by Prof. Dewar to the British Association at their Belfast meeting naturally divides itself into two portions, the larger treating of that special department of science, viz., low temperature research, with which the author has of late years peculiarly identified himself. Before entering upon his proper subject, however, Prof. Dewar devoted some attention to the question of scientific endowment and to the relative importance of industrial chemistry in Great Britain and Germany. Prof. Dewar quotes a consular report to the effect that there are 4,500 trained chemists employed in German works, while, on the authority of Prof. Henderson, of Glasgow, he considers there to be only 1,500 factory chemists in England. The smaller number is not compensated for by superior intelligence or education, since 84 per cent. of the Germans have been systematically and thoroughly trained, whereas only 31 per cent. of their British brethren are similarly equipped. Although the figures relating to the 1,500 English chemists have been calculated from information supplied by only 500, the conclusions may be sound; and so, in all probability, is the assertion that English chemists are not superior to Germans. But we are not prepared to admit the individual inferiority of the trained English chemist; the lower percentage of trained men in this country is due to the amazing shortsightedness of British employers who frequently put in control of their factories men calling themselves chemists on the strength, perhaps, of a single course of evening lectures. In spite of Prof. Dewar's sneer at the Institute of Chemistry, we cannot regard the qualification that body grants as valueless, for it is not given only "for questions asked and answered on paper." As long as the capitalist declines to insist on having a "F.I.C." in his laboratory, so long is he liable to engage a man of no real worth to him; as long as he is exposed to that peril, so long will he refuse to offer reasonable salaries; and as long as the salaries are small, so long will men hesitate to pay for a long and costly training before applying for industrial positions. That is the vicious circle obtaining in this country, as we have repeatedly urged; and the people who must leave it first—who, in fact, are alone able to leave it first—are the capitalists; for as in trade so in education, the demand must always precede the supply, and "the man who pays the piper has the *power* to call the tune." Prof. Dewar's statement that the German chemist is of more immediate use to the manufacturer than the Englishman when the training of either is complete, is, if generally true, only another aspect of the same question, because technical utility comes from experience alone. Experience is a product of time, time means a longer educational course, a longer course means greater expense, and the heavier expense is only justified by promise of greater reward.

We have written of chemists because Prof. Dewar speaks of chemists, but the same thing applies to engineers, electricians, electro-chemists, and all classes of professional men. A curious light is thrown on the British public's contempt for qualification, in the fact that many persons apparently find it to their interest to place the mystic letters "C.E." after their names. Another, of almost appalling magnitude, is that of a huge manufacturing concern in the metropolis, whose capital amounts to millions, where the plant is of extreme complexity, and the processes involve most obscure chemical reactions. It would puzzle any man of science to name the chief technical advisers of this company, or to mention any great advances or important discoveries in science or art ever made by its employés.

The main portion of Prof. Dewar's address is taken up by a history of cold and absolute zero, and here, remembering what we have written, we meet with an interesting phenomenon. In 20 pages of closely printed matter the author mentions the names of some 62 investigators hailing from practically all the civilised nations of the world. Of them roughly, 24 (*i.e.*, 38 per cent.) are British, not altogether a despicable proportion surely! We have no space to review or abstract Prof. Dewar's observations on the position of affairs in this amazingly interesting field. Wonderful advances have been made in the 180 odd years since Fahrenheit called the freezing point of water 32°, because the temperature of melting ice and salt appeared the lowest possible of attainment, and he wished to avoid the minus sign. Now we have reached −436° F. or −260° C.; in other words 13° on the absolute scale. It might seem a very simple matter to do away with those 13 degrees, and yet they offer an insurmountable obstacle; we may one day halve the distance or even reduce it still further, but the ideal zero will not improbably ever elude our grasp. On the present occasion Prof. Dewar has not given us much fresh information, but he has ably described the progress which has been made, and his address is well worth study, for it shows repeatedly how the existence and properties of substances have been predicted with accuracy long before they were or could be prepared; and so it cheers the student on his path, counteracting any depression caused by the business man's contempt of science, and plainly proving the fallacy of the journalist's catch-phrase that an ounce of practice is worth a ton of theory.

THE "DOLTER" SURFACE CONTACT SYSTEM.

When someone has something to sell, which it is hoped will supersede articles which have hitherto performed certain functions, it is amusing to note how, before dilating on the merits of the new comer, the forerunners are all set up in turn with their unprotected parts foremost, only to be knocked down and carried off the stage, in as short a time as is decently possible, with all wounds showing.

Then, after the poor rag-doll dummies, comes the Fairy Prince, glittering in his armour *cap-à-pie*, which, to the man with the cudgel, looks so impenetrable that he is fain to conceal his imbrued weapon the while he bends low to the Prince, and belauds him to the skies.

Not otherwise is the method by which the "Dolter" system is brought before us. Whether the armour of the Fairy Prince in this instance is of chain-mail or tinsel, remains to be seen, when it has been subjected to wear.

The book—for it rises to that dignity—in which the Dolter Electric Traction, Limited, expound the simplicities of their system is solidly bound in stiff cloth, the text being beautifully printed on glazed thick quarto, very fully illustrated with wood-block and half-tone engravings. The company appear to have no trade secrets to conceal, for every detail is carefully explained; and not only so, but the description throughout is written in a style which will appeal to the layman and interest the professional at the same time. We emphasise the artistic excellence of the production, because it comes as a distinct relief after the thousand-and-one pamphlets which are put into the W.P.B. without regret. Without a feeling of vandalism it would be impossible, even if it were desirable, to consign this booklet to that limbo.

We were most favourably impressed at the outset to find that the Dolter Company do not express their abhorrence of the overhead system, nor try to make us believe that nothing but a surface-contact system is tolerable, or even commercially possible. They merely state that this system, and the Dolter system above all others, is preferable to the accumulator system and the conduit system in towns or streets where the overhead trolley is forbidden, and we take it that this is the only reasonable attitude to adopt. The task of discussing the accumulator system to destruction is performed with grace, but we would suggest that to do so at all is rather like beating a dead dog; although, under exceptional circumstances, two accumulator cars have been placed this year on the Mumbles Light Railway. Then the conduit is taken in hand, and the usual valid arguments are adduced against its use. We think that the last word on this subject was said by Mr. Rider, when he stated that the conduit system is not commercially practicable unless the traffic is so dense as to call for a service of two minutes or less. There is no doubt that the surface contact comes next to the trolley in cost, though estimates as to how much greater this cost is vary considerably; and the conduit should show very great

advantages, or the surface contact very great defects, before the former is selected to run where the trolley is barred, as its cost is so enormously higher.

All contact systems look beautiful on paper, and work to perfection in an exhibition, but the only practical system is one in which the moving parts of the underground portion are reduced to the utmost limit. The chief desiderata are

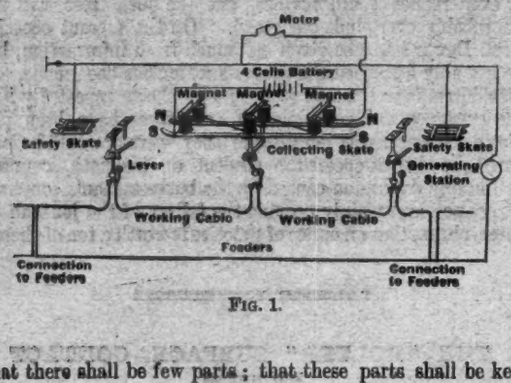


Fig. 1.

that there shall be few parts; that these parts shall be kept absolutely water tight; that there shall be the least possible chance of any contact remaining alive after the collecting skate has left it; and that, if such an accident does occur, the contact shall be cut out of circuit automatically before the car has exposed the surface stud to traffic.

From the evidence before us, we gather that the Dolter system satisfies all these requirements, but it must be remembered that the system is working as yet on only a portion of the Parisian tramways, and we have not had an opportunity to watch it in operation for any length of time. Before any authoritative judgment can be pronounced on a surface contact system, it should have been in constant operation under normal conditions for at least three years. The effects of depreciation on every detail will have been recorded financially by that time, and it is to be reasonably expected that no defect will have remained undeveloped.

Bury the overhead system and put a section insulator with an automatic bridge-piece, or "jumper," where there were cars before, and you have a more or less accurate notion of the Dolter system. Along the centre line of each track runs

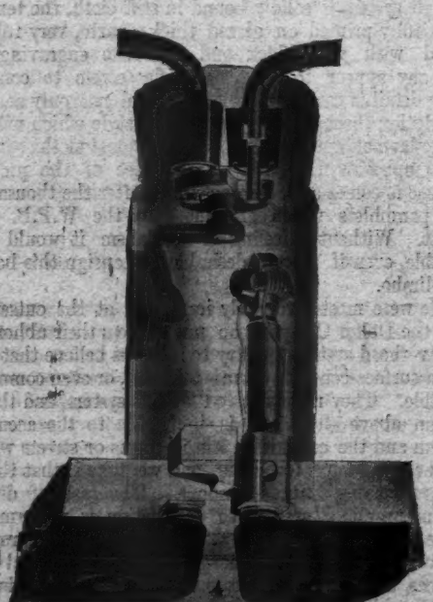


Fig. 2.

a pipe containing an insulated cable equivalent to the trolley wire. At intervals, which are regulated only by the length of the cars to be run on the line, the cable is taken up into the throat of a tee-piece, cut, and the ends connected to a well-insulated terminal plate. Fitting over this and held in position by a cast-iron chair firmly embedded in asphalte or other suitable material, is the tubular chamber containing the switching gear. This chamber is composed of an insulating waterproof material. The upper portion of the chamber holds the surface block, which consists of two slightly projecting pieces of cast-iron, separated, for magnetic purposes, by a piece of manganese steel.

Fig. 1 gives a general diagram of connections below ground and on the car; fig. 2 shows the complete contact stud without the supporting chair, and fig. 4 is a cross-section of the magnet and stud in position. The switch is wonderfully simple, consisting only of a piece of carbon fixed in a suitable insulator to the side of the chamber in constant

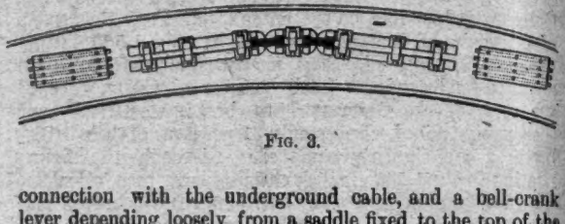


Fig. 3.

connection with the underground cable, and a bell-crank lever depending loosely from a saddle fixed to the top of the chamber, the lower end being furnished with another carbon block, while the horizontal portion forms the armature which is attracted upwards when the energised magnet on a car passes over. The movement of this armature lifts the at present dead carbon block into contact with the fixed and permanently alive block, and so transmits current through the surface stud to the skate. Immediately the magnetic effort ceases, the bell-crank returns by gravity to its original position, thus breaking contact with the cable.

As the skate is always on a second stud before leaving the first, no current passes between the carbon blocks, and therefore no arc is formed under normal conditions; but it is

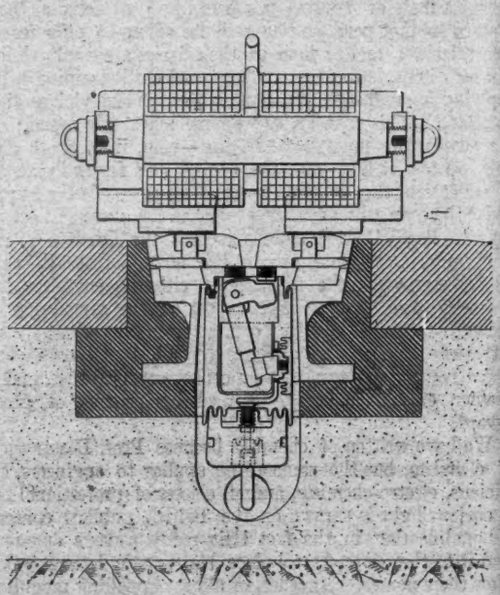


Fig. 4.

always better to make provision for the unexpected than to state simply that it cannot occur, and, in this case, if an arc does start, it is blown out at once by the magnetic action of the solenoid s, fig. 2.

It is stated, naturally, that the chance of a stud remaining alive is extremely remote. In case this should occur, however, earthed guard skates are carried at each end of the car. These pass over every stud, and short-circuit any one which is alive. This results in the melting of a fuse in the contact box itself, and merely cuts out that one box. We believe that, in other systems, such an occurrence would temporarily disable sections of considerable length.

It is stated that "long-continued tests under trying conditions of roadway have proved that there is no diffi-

culty in maintaining efficient insulation of the contents of these contact boxes."

In order to minimise leakage and the possibility of accidents, it is essential that the containing boxes of any surface contact system be examined, tested, and cleaned at frequent intervals. The Dolter system allows this to be done with ease and promptitude, as no bolts or nuts have to be undone, two lifting keys only being required to remove the whole chamber. (We may be permitted to suggest that the reason why the man on p. 25 wears a worried look, while performing this operation, is that the engraver has made the insulator into which the cable ends go much too large for the hole from which we are asked to believe it has just emerged. Perhaps, too, he is afraid that he may be run over at any moment, as he has turned his back in the direction of any approaching car, although the engraver's idea of perspective leads one to think that any car would inevitably leave the rails before it touched the man. We would suggest, too, that it is unusual on a wide boulevard to place the inner rails of two tracks within an apparent distance of 9 in. of each other. It is too bad, though, to criticise the only bad engraving of the lot.) Fig. 6 is an outside view of the stud and terminal.

Turning attention to the equipment of the car, we find that the additions required to the ordinary trolley car are the collecting skates and magnet system, two safety skates, and a small battery of accumulators. Of course there would have to be a certain duplication of wiring and the provision of a two-way switch to permit the car to run either on the contact or the trolley system.

The collecting skates are formed of two iron bars with upwardly curved ends, which make the north and south poles of the magnets; six energising coils being divided over the lengths. In fig. 1 these coils are shown as if wound with series turns only; but unless the car lighting is done by means of the accumulators—as it well might be—it would seem necessary to provide a shunt-winding also. It is a good feature of the system that the actual magnet poles are made to collect the current as well. If we are not mistaken, in the Lorain system, which is somewhat similar to the Dolter, the collection is done by an auxiliary phosphor-bronze skate, the heavy wear of which makes its maintenance expensive. By decreasing the air-gap to nothing, the Dolter Company are able to reduce the constant waste of energy in the magnet coils, and can decrease the size and maintenance of the emergency battery.

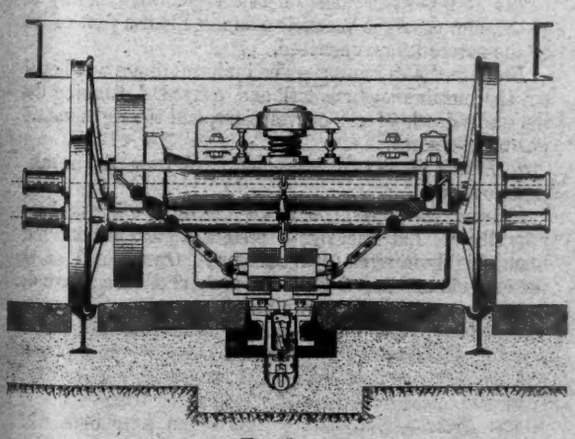


Fig. 5.

Fig. 3 shows the flexible construction of the skate. Although the text does not say so, this curving action could be applied only on a double-truck car. If only to obtain this advantage, and the additional one of maximum space between studs and fewer of them, it would be wise to use double-truck cars on such a line, for then all studs would be in the centre of the track throughout, instead of being dangerously near the rails at any curve.

The skate is suspended freely from the axles, and well insulated therefrom. This matter of suspension is a very important one, and the Dolter Company are to be congratulated on their design. The weight of the magnet-collecting system is quite sufficient to make good contact on a dirty stud, and any wear on the skate can be taken up very easily by slacking off turnbuckles or strain-insulators. We believe that this can be done from inside the car, whereas, with the Lorain system, we understand that for any adjustment of this nature the car has to be shedded. This scheme of suspension is shown in fig. 5.

The battery is connected in parallel with the series windings of the skate magnets, so that it may be charged while running. Doubtless there is a foot, or hand, switch to connect or disconnect the battery at will.

As the cables corresponding to the trolley wire are run loose in pipes, and are cut every six or eight yards, it is the simplest matter to pull out a length and pull in a new one at the same time, if there happens to be a fault; but we do not see why there should be more trouble with these cables

Fig. 6.

than with the ordinary feeder cables; and they have at least one advantage over the trolley wire, in that a much heavier section can be carried, although it would be too much like putting all the eggs in one basket to do away with the feeder altogether. This would be undesirable for several reasons.

The book contains two photographs of cars running on the Bois de Boulogne route, and the translation of a Ministerial letter to the Prefect of the Seine authorising the *substitution of the Dolter system for the Vedovelli and Priestley surface-contact system* on the line from Neuilly-Porte-Maillot to Suresnes. This permission was given on the strength of a report from the Government engineers on the working of the Dolter system on the short track between the Porte-Maillot and the Porte des Sablons, and the engineers also state that the system is better than the Diatto, which is working in Paris among the medley of other systems, and if newspaper reports are to be credited, has the death of many horses, and some human beings, to its charge.

It is interesting to note that one of the conditions on which the above permission was given, is that the contact studs shall not project more than 15 mm. above the level of the rails, nor more than 10 mm. above the crown of the road. Undoubtedly this condition would not have been inserted unless it had been found feasible in practice, and we may congratulate the Parisians on the possession of at least one line on which the studs do not form a constant menace and source of irritation to foot and wheeled traffic.

At the end is printed a report from Messrs. Mordey and Dawbarn, consulting engineers to the company, in which the system is briefly described. They state that they examined the carbon contact blocks after cars had taken current from them about 25,000 times, and found hardly any signs of wear. They will last a very long while, and can be replaced

ultimately at a trifling expense. After the statement that the possibility of a stud remaining alive after the passage of a car is extremely remote, the most interesting is that the energy spent in energising the magnets of the collecting system is less than 1 per cent. of the energy used by the car, and that the annual consumption of energy would not be more than 5 per cent. over that used by a similar trolley car.

A leaflet is inserted bearing a statement by the managing director that, after running an average mileage of 7,000, and a maximum of 9,663 miles, with 12 cars, the skates have neither given trouble, nor necessitated any repairs. These cars are equipped with trolley and skate.

Since writing this, we learn that the Torquay Tramway Committee have decided to build their lines on the Dolter system. They would not have the trolley because of its alleged unsightliness, and both the conduit system and the Kingsland mechanical contact system were considered unworkable because of the drifting sand. Swansea, on the other hand, is adopting the Kingsland system.

NATURAL GAS IN ENGLAND.

PROF. DEWAR'S remarks in his presidential address to the British Association this year at Belfast, in regard to the effect of our defective technical education, appear to be borne out by the tardy way in which the searching for natural gas in this country has been carried out.

In the United States this valuable gas has been tapped and utilised for years, and a comparison of the geological stratification of the regions where it has been found in abundance in the States with the geological formation of this country, has indicated the probability of a supply of this gas being within the reach of enterprising searchers in England.

Even more than 25 years ago, an explosion, caused by lowering a light into a bore-hole at Netherfield, indicated the presence of inflammable gas.

In a lecture delivered before the Halifax Lit. and Phil. Society, in 1886,* Mr. B. H. Thwaite predicted that natural gas might be found in Cheshire. In 1887 it was seriously considered by the Salt Union. Mr. Thwaite obtained the opinion of the leading experts in the States, and they were strongly of opinion that the geological strata were of such a character as to thoroughly justify a test bore-hole being put down to 3,000 ft. In fact, they were so satisfied at the promise of such a test that they undertook to carry out the boring at net cost to themselves; these same drillers were the discoverers of natural gas in Pennsylvania.

A contribution to the *Times* of the 10th inst. gives some very important particulars of the accidental discovery of a supply of natural gas at Heathfield, Sussex, and the progress made towards its successful application for power, heat, and lighting purposes. It appears that about six years ago while boring for water, near Heathfield Station, natural gas was found; and though the possibilities of an extensive supply do not seem to have attracted much attention, the railway company made use of the gas which collected in the abandoned bore tube, to light the station. However, some American gentlemen got to hear of the find, and their knowledge of the value of natural gas in America enabled them to bring about the development of this most valuable fuel supply.

At Heathfield the gas is met with at depths of from 377 ft. to 400 ft., though at greater depths the supply may be found to be more abundant, and as it occurs in the strata known as the Kimmeridge clays, which extend over a large area in England, it is probable that some important developments may rapidly follow the lead given to us by our American friends.

The deepest boring at Heathfield is said to be capable of giving an output of 15 million cubic feet a day, which alone is very considerable. The gas differs from that found in the States, in that it contains sufficient illuminating gas to enable it to be used in ordinary burners, giving, without enrichment, from 12 to 14 C.P. Though the gas is at present utilised for illuminating purposes, and for combustion in gas engines for power purposes, we do not find that the pressure, varying as it does from 140 to 200 lbs. per sq. in., has been utilised for developing power by means of "compressed air" engines.

Taking the supply from the single bore hole referred to at 15 million cub. ft. per day at a pressure of 200 lbs. per sq. in., representing as it does some 9,000 H.P., it is apparent that if this gas were used to develop power simply by its expansion, something like, say, 5,000 H.P., could be developed without impairing the quality of the gas for combustion purposes, while at the same time its pressure would not be reduced below that necessary for conveying it over gas-pipe lines to very considerable distances. In ordinary gas works it is seldom necessary to raise the pressure to more than 2½ in. of water, showing a margin of nearly 200 lbs. as available for expansion purposes.

* *Halifax Guardian.*

DEATHS FROM ELECTRIC SHOCK.

THE recent discussion at the Institution of Electrical Engineers showed a considerable divergence of opinion as to the way in which electric shock causes death. The evidence available is small in volume, hence the following accounts of *post mortem* examinations in recent cases have considerable value.

The victims were horses; the shock was due to a potential difference of about 500 volts between earth and some wires which fell on to the horses.

1. *Post Mortem Examination of Brown Horse.*—This animal died from the result of electric shock.

External Marks.—Wire burns inside of near knee, both hind fetlocks, off hip and off hock, also off shoulder. Blood exuding from both nostrils and extreme rigour present. Visible mucous membranes highly injected. On removal of skin the external muscles of shoulder, ribs, flank, and panniculus carnosus showed lesions such as would arise from burning. The muscular tissue had a peculiar greyish-red or purple appearance; the external jugular was blocked with blood, which presented a dark, tarry appearance. The cutaneous vessels were congested, and over the seats of injury had ruptured, and the dark-coloured blood before described was issuing from them.

The Heart.—The walls of this organ were highly congested, and the right ventricle contained half a pint of blood of the nature before described.

Brain and Membranes.—The brain substance was healthy, but the membranes were dark and congested, running down the whole depth of the convolutions, and the right ventricle was blood-stained.

2. *Brown Horse.*—This animal died from the result of electric shock.

External Marks.—Wire burns four or five in number on near elbow. Extreme rigour present, visible mucous membranes highly injected (claret colour). On removal of skin the external muscles of shoulder, neck and chest, were deep in tone, altered in colour to a purple grey tint. The external jugular was blocked with blood, which presented a dark, tarry appearance. The cutaneous vessels were congested, and over the seat of injury had ruptured, and the dark-coloured blood before described was issuing from them.

The Heart.—The walls of this organ were highly congested, and the right ventricle contained half a pint of blood of a tarry nature.

Brain and Membranes.—The brain substance was healthy, but the membranes were dark and congested, running down the whole depth of the convolutions.

3. *Black Horse.*—This animal died from the result of electric shock.

External Marks.—Burnt in four or five places from the posterior part of elbow to anterior portion of chest, the longest one being about 15 in. and 1 in. deep. Rigour present, visible mucous membranes injected. On removal of skin, the muscles of axilla, neck and chest, showed lesions such as would arise from burning. The muscular tissue had a peculiar greyish-red or purple appearance. The external jugular was gorged with blood of a dark, tarry nature. The

cutaneous vessels were congested, and over the seat of injury had ruptured, and oozing from them was the dark-coloured blood as previously described.

The Heart.—The walls were congested, and the chambers contained blood of this tarry tint.

Brain and Membranes.—The brain substance was normal in character, but the membrane covering it, and running or dipping into the convolutions were congested.

The Stomach of this animal was ruptured, due to some sudden shock.

In a later letter the surgeon states that in all cases the appearances were those of death from respiratory paralysis.

These cases afford strong encouragement to persistence with the artificial respiration method on human beings in cases of apparent death from shock.

POSTAL GRIEVANCES.

The second Postal Congress recently held at the Holborn Town Hall was representative of 45,000 postal and telegraph employés in all parts of Great Britain and Ireland. The President, Mr. C. H. Garland, in his presidential address cannot be congratulated on the moderation of his utterances. Substantial grievances, those whom Mr. Garland represents may very likely have, and it may be also admitted that it will require a perpetual agitation to obtain such redress as those in question may justly claim. Such agitation may be admitted to be perfectly legitimate, and, indeed, those in authority concede this; it may be doubted, however, whether the intemperate manner in which such agitations are too often conducted, and in many cases the absurd pretentions put forward and the utter nonsense spoken which is supposed to do duty for solid argument, does not do very great damage to what would otherwise be a very reasonable case. What are we to think of such a statement as the following—"The Post Office has so far fallen from the conception of its high function as the efficient servant of the brains of the land, that it has been debased into a system of which the prime duty is to filch from every purchaser of a stamp some fraction toward the huge profit of £4,000,000 which it produces annually." Again, can it be seriously believed that any possible good could arise from such a speech, as a Mr. Mosdale is credited with having made at the Congress, namely, "it was a scandal and a shame and a disgrace that the treasurer should sit on the money bags containing £4,000,000 profit—money bags bound with bonds, stained with human blood—while those who made the profit were paid starvation wages."

We should like to ask what is actually meant by "starvation wages." Unreasonable profits we do not attempt to justify, but the payment of what agitators would possibly admit (though this is doubtful) to be fair wages would in very many cases mean not "reasonable" profits, but no profits at all.

As regards the petition of the women clerks with reference to the cost of living of a girl in London, what is stated may be true, yet numbers of girls live at home and do not pay rent or laundry. They may possibly give so much per week towards the home. Thousands of girls in employ do not get anything like the £1 per week to which the petition referred. It has been argued, and with good reason, we think, that wages sufficient to make every girl independent is not by any means a desirable thing, as the loss of home influence would be, in the majority of cases, a most serious matter. £4,000,000 per annum is stated to be handed over to the Treasury. The Treasury, we presume, is a private company, whose shareholders divide this £4,000,000 amongst themselves and live opulently. If this is not so, will Messrs. Garland & Co. please state what is done with the amount, and explain how the Treasury can carry on the affairs of the nation quite easily without it?

ENGLISH AND AMERICAN ENGINES FOR THE GLASGOW TRAMWAYS.

No apology is needed for reverting once more to this subject—so much has been added to the information available since our last article was written. To begin with, our esteemed contemporary, *Engineering*, in its issue for 12th inst., repents in sackcloth and ashes, to the extent of five columns, of its misguided and prejudiced attitude to which we drew attention.

By way of confusing the issue, our contemporary digresses to recapitulate the history of the Corporation tramway undertaking from the commencement. It is pointed out that the Committee decided "to secure as their consulting engineer the man who had most experience in electric traction, and who was in close touch with the most advanced American practice." That Mr. H. F. Parshall was the only engineer in this country who fulfilled these conditions will, we think, be disputed by no one. Commenting on the Committee's recommendation to the Council that the whole of the contract should be given to the E. P. Allis Co., our contemporary says, "fortunately that body [the Corporation] did not share the views of the Committee," and quotes back numbers to show how it had backed up British manufacturers in those days, who "can make steam engines equal to any in the world, and although they have not the costly, and in some instances the disastrous, experience of tramway engines which is current in America, yet they are quite equal to fulfilling the requirements of consulting engineers if these are put before them in concrete form." We agree that the disastrous runaways and breakdowns with which American engineers were afflicted did not take place here, and it was therefore superfluous for us to invent untenable theories as to excessive strains, &c., though it was hard work nailing the fallacy to the counter.

The contract for the four engines was offered to Messrs. John Musgrave & Sons, Limited, but they could only accept half of it, on account of the limited time for delivery; the contract was therefore divided, and half given to the Allis Company. The latter were to receive £57,000, as compared with £47,000 paid to the British firm, the difference being practically a premium for early delivery. The engines were ordered on September 7th, 1899; the first Allis engine was delivered in October, and the second in November, 1900, but the power station buildings were so backward that erection could not be begun until December 21st. The first engine was ready for steam by March 13th, 1901, but the steam was not available until April 4th, and the engine was turned round for the first time on April 10th. The second engine was ready for steam on April 24th. It is fair to emphasise the fact that, had the buildings been completed in time, the engines would have been ready by the specified dates, February 7th and March 7th, 1901.

As we have pointed out, neither engine could be used for driving the cars until the end of May.

Delivery of the Musgrave engines, we are told, began on February 11th, 1901, but as the cranes were required for the erection of the Allis engines, it was not till the second week in May that the work of erection was actively pushed on. The first engine was ready for steam on June 24th; the erection of the second engine, which was not wanted, was purposely delayed, so that this engine was not ready till November 1st.

Each of the four main engines was under adjustment for about a month, and the diary of the initial troubles of all of them, as well as of the Stewart auxiliary engines, as given in *Engineering*, is of great interest. The chief difficulty with the Allis engines appears to have been in the fitting of the big ends of the connecting rods. Those of No. 1 engine were eased on April 12th to 15th; nothing further is recorded until May 8th, but we know that the engine was not at work on the car load in the interim. On that day one of the main bearings and one of the big ends again gave trouble; on May 9th another bearing heated, and on the 10th a big end seized. From May 11th to 20th the big ends on both engines were under alteration. Between June 7th and July 2nd there were five stoppages of one engine or the other. Both engines ran their 80 days' trial in July, 1901.

The initial troubles of the first Musgrave engine comprised a variety of mishaps. The chief of these was the heating of the crosshead slides, which caused trouble on five occasions, until the shoes were refitted. On two occasions No. 5 main bearing heated, and in four instances one of the valve bonnets cracked, though this did not always lead to a shut-down. These troubles occurred between July 4th and August 29th, 1901. The other Musgrave engine ran well from the first, being almost entirely free from trouble. Our contemporary severely condemns the backwardness of the buildings, which seriously handicapped the contractors, and praises the Corporation for its wisdom in dividing the contract, even at the cost of £10,000 extra for a few weeks' earlier delivery. In the end, however, the advantage hoped for was entirely lost, owing to the delay in the building operations. The erection of the first Musgrave engine began on February 20th; had the cranes been available, allowing 100 days for completing the erection, the engine would have been ready for steam by the end of May.

The concluding paragraph of our contemporary's article is delightful reading, after the high flown eulogy which it passed upon the American engines a few weeks ago. All the praise is now for the Musgrave sets. Thus, "in this class of work, we have nothing to fear from American competition .... at least one (!) firm of British manufacturers can hold its own against the best American makers."

"Handicapped as Messrs. Musgrave & Sons were, with price enormously against them, without previous experience of this special class of work, and without the special plant necessary, they yet filled the contract with but little delay; and their engines, if a shade less economical than those of the E. P. Allis and Co. (*sic*), are at least as satisfactory from every other point of view, and more so as regards combined efficiency."

Our contemporary goes from one extreme to the other—rather late in the day. We admire neither the present panegyric nor the past; what we demand is justice, without respect to persons or nationality. In order that this may be accorded, either full data should be published, or none at all. In this connection we are puzzled to account for the fact that we received from Mr. John Young only the actual figures of Prof. Barr's tests, which we published in our last issue exactly as received. In the *Light Railway and Tramway Journal* of 12th inst., we note that Prof. Barr's comments on the report are also given; from these we learn that during the Musgrave tests the vacuum was not up to the standard called for in the guarantee, so he credited the engines with the extra I.H.P. *that would probably have been got* had the vacuum been at its specified value. Again, commenting on the Allis engine tests, Prof. Barr says that the mechanical efficiency, "*though not unprecedented*," was so high that he felt it necessary to examine the observations and calculations very carefully before committing himself to a statement of it; but he was satisfied that the figures given "must be" very near the truth. The value of the B.H.P. deduced from the E.H.P. was checked by taking the I.H.P. at no load, and subtracting the latter from the I.H.P. at full load; "the check comes out as close as could be expected."

The I.H.P. at no load was one of the data that we most particularly wished for. True, we have not got it even now; but we know it was observed. Why was it withheld? And why were we furnished with an incomplete version of the report?

We may close these notes with a further allusion to American methods. A large illustration of the interior of the engine room at Pinkston is given in *Steam Engineering*, of Chicago, for May 15th last; the two Musgrave sets are in the foreground, the Allis engines being almost wholly concealed behind them. Yet the legend under the illustration reads "5,000-H.P. units in Glasgow Tramways Station; engines by Allis, Chalmers Co., Milwaukee; generators by British Thomson-Houston Company." The article in which this appeared was signed by an American writer, Mr. F. C. Perkins. We cannot, of course, express an opinion as to the source of this unfortunate misdescription, but it is to be regretted that such errors should be allowed to occur—especially in connection with such a delicate matter. A correspondent informs us that the same sort of thing happened in a recent issue of *Power*—another American journal.

REVIEWS.

Modern Gas and Oil Engines. By Frederick Grover, A.M.Inst.C.E. Third Edition. Manchester: The Technical Publishing Company, Limited. 1902.

The second edition of this work was issued in 1897, and in the five years since its publication considerable progress has been made in the manufacture and improvement of gas engines, more especially in regard to increase of proportions and the application of gas of low thermal capacity for the cheap development of power. The second edition contained 256 pages, while the present edition includes 372 pages, so that besides bringing some of the chapters more up to date, a considerable amount of new matter has been introduced.

We shall confine our remarks chiefly to the additional matter included in the new edition, as being indicative of the advances made in gas engine design and construction since the last edition. In the "types" of gas engines there has been added a description of the "Gardner" gas engine. In this engine eccentrics are employed for actuating the valves instead of cams, and the governor is of the inertia type. Simplicity seems to be the chief point, but this type would probably not be adopted for engines of large proportions.

The Westinghouse gas engine has some pages devoted to its description, with several illustrations. This engine is of the vertical multi-cylinder type, the principal feature of novelty, perhaps, being the method of governing by increasing or diminishing the total volume of mixed gas and air admitted to the cylinder, while the quality remains constant as fixed by the attendant. Electric ignition is employed, and starting is effected by compressed air. The Westinghouse Company are said to be building engines of this type of 1,000 B.H.P.

The chapter dealing with two-cycle engines is extended by a description of the Oechelhaeuser engine. These engines are especially designed to use such gas as that produced in blast furnaces; there are two pistons working in opposite directions in a long cylinder. Though there is an almost entire absence of valves, this advantage is obtained at the expense of a complicated crankshaft and side rods, with connecting rods and crosshead to connect the back piston to the crankshaft, as well as a pump cylinder for the gas and air mixture on one side, and scavenging air on the other. This type of engine has been constructed up to 1,000 H.P. for use with blast-furnace gas.

The section of practical analysis is extended by a description of the Orsat-Lunge gas analysis apparatus, which is specially useful and handy for analysing blast-furnace gas, and other similar mixtures, as well as products of combustion. While being fairly accurate, it is simple in manipulation, and does not require handling by a professional chemist.

The extension of the chapter on "Producer Gas," of course, includes the producer invented by Dr. Mond, which differs considerably from the more common type previously employed. This system allows of the employment of cheap bituminous coal slack for fuel, instead of anthracite or coke, but its fullest economy involves the recovery of by-products, for which purpose considerable additional apparatus is required in the form of towers for the recovery of the ammonia, &c. While the thermal value of the gas given off is not higher than that from ordinary producers, it is more constant in quality, which is a very great advantage. The capital outlay upon this type of producer is very considerable, and it is said not to be economical unless upwards of 20 tons of coal is gasified per day. In the utilisation of this gas for power distribution purposes by means of pipes, of course the cost of conveying gas of such low thermal capacity, diluted as it is with nearly 50 per cent. of nitrogen, must be taken into account.

The latest Lencauchez producer is described and illustrated, but does not appear to call for special mention; it has generally been applied to using poor French anthracite or non-bituminous coal. The air is supplied under pressure and water is admitted about 1 ft. above the fire bars; it is fitted with tower scrubber and gas holder.

We are surprised to find that more information has not been given regarding the large class of gas engines which have been developed through the application of blast furnace

gas to the production of cheap power. This gas, when freed from dust and moisture, has been found to be superior in many points to any generator gas. It is very constant in quality, and is available in such immense volumes that its utilisation has involved the design of gas engines of large power units, such as would never have been attempted while the available systems of gas generation were the only source of power.

Though British ironmasters have not been so enterprising as those on the Continent, there are some who have availed themselves of this source of power, notably Sheepbridge Coal and Iron Company, Limited, who have provided the power for their pipe foundry and new furnace from gas engines, using gas from their blast furnace, and the Clay Cross Company with their gas-driven blowing engine, on the Thwaite-Gardner system, the Cochrane Company with a Cockerill engine, and others.

While for coal gas a piston speed of 700 ft. per minute is given as unadvisable to be exceeded (p. 181), poor gas of the blast furnace class allows of 800 ft., and instead of having a very high maximum pressure in the cylinder at the commencement of the stroke-up to 2·5 to 3·5 times the compression, a relatively high mean effective pressure can be obtained with a maximum pressure only about twice that of the compression, thus reducing the excessive stress on the crankpin at the commencement of the stroke, which is chiefly expended in heating the main bearings, and, of course, necessitates a relatively smaller crankshaft to resist the twisting and bending stresses. Any gas, such as coal gas, coke oven gas, natural gas, or ordinary generator gas where steam is used, including Mond gas, is liable to pre-ignition if the compression is carried very far, while this is not the case with blast-furnace gas, as the proportion of hydrogen is so low. With small engines using coal gas, the limit for compression was something like 90 lbs., whereas with gas of low thermal value, as blast-furnace gas and Mond gas, the compression can be increased to 140 lbs. and upwards, with an accompanying increase in efficiency.

Electrical engineers would have been pleased with more information on such points as cost of lubrication and attendance compared with steam practice, reliability for continuous running, repairs and upkeep, cyclic irregularity, performance when driving alternators in parallel, &c., but these points are not dealt with in detail.

The dynamic gas producer described is a very good arrangement for manufacturers requiring small units of power, and will, no doubt, prove an acquisition. A new chapter is devoted to acetylene gas.

Separate chapters are devoted to "Gas Engine Efficiencies" and "Entropy Charts Applied to Gas Engines," which cannot fail to interest students in internal combustion engines. The development of the "Oil Engine" has involved additional matter in this respect. Some interesting matter is given in regard to the development of the Priestman oil engine well worthy of attention by those interested in the subject, and the same may be said of the Hornsby-Akroyd oil engine. The Crossley oil engine and the Campbell oil engine have received further attention, including tabulated results of a test on the latter. The Gardner oil engine and the Diesel oil engine are described, and a chapter is added on "Oil Gas Engines," while the Daimler motor has considerable additional matter.

With the exception noticed, this new edition is considerably advanced, and is probably the best book that can be put into the hands of those interested in internal combustion motors.

Konstruktionstafeln für den Dynamobau. By E. Arnold. Stuttgart: Ferdinand Enke.

These form a complete series of working drawings of dynamos, alternators, motors and transformers, with their details, arranged in two parts, which can, we believe, be obtained separately. The first part, which is now in its fourth edition, deals with direct current plant, while the second, in its second edition, deals with single and polyphase plant.

The author of this collection of drawings is the well-known head of the electrical side of the Karlsruhe Technical University, and the consulting engineer of several of the largest European firms; needless to say, therefore, the designs given have been selected with great care. They represent the standard practice of the best German, Austrian, Belgian, French and Swiss firms, and are thoroughly typical of modern work. Each part consists of 60 scale drawings of machines, and of the details of the same, being for the most part accompanied by full dimensions and by the electrical data. They are all executed in the best possible style, on separate sheets, the printing being black lines upon a white ground; the net size of each sheet is about 16 × 12 in.

Each collection is prefaced by a very complete schedule, in which are embodied the leading dimensions of each machine, together with the magnetic and electrical data. In addition, in many cases, certain quantities have been worked out, which serve as a criterion of the sparking limit, reaction, or pressure drop, as the case may be; the schedule for Part I. has been made with special reference to the author's new treatise on "Direct Current Dynamos," to which excellent work those interested should refer.

The two collections, accompanied by these schedules, are excellent, and should be obtained by every designer, for they are bound to be of considerable service. They differ from certain other collections, which have been published from time to time, in the fact that the designs in question represent up-to-date *standard* constructions, and that the full information relative to them is given, so that the actual machines could be readily constructed from them, if desired. Prof. Arnold is to be congratulated on his efforts, and also thanks are certainly due to the many firms who have evidently given him a free hand in making use of their working drawings, which embody the results of their experiences and latest ideas.

CORRESPONDENCE.

Sales: A Criticism with Supplementary Notes.

Your article upon "Sales"—the commercial side of manufacturing as distinct from the actual manufacture—presents many points of interest to those engaged in present day commercial undertakings. Indeed, it opens up a fertile field for suggestion. It is one thing to produce, but quite another thing to sell, even where the article offered for sale may be of proved merit.

There has been of late years nothing short of a revolution in workshop practice—in the conditions under which machinery and other goods are manufactured in this country. American methods in system and organisation—if not entirely, in part, at any rate, are being adopted; and where new works have recently been laid down by old established firms, the equipment of the workshop on modern lines has received a very practical and intelligent appreciation.

Undoubtedly the conditions of manufacture are changing, and it is only the firms who are thoroughly up-to-date, and who are deliberately setting themselves to keep abreast of the times in practice and plant, that can hope to survive the competition which now exists among home manufacturers, not to speak of competition from abroad. It is such firms, alive to present-day needs, resourceful and enterprising, willing to adopt every recognisable advantage, who will achieve success. There are, of course, those who will continue to go the old way, acting as a sort of permanent drag or brake on the wheels of their own progress, and such must sooner or later come to grief.

Now, while it may be necessary to the manufacturing side of a house to reform—and to reform with results—it is equally necessary to attend to the efficient organisation of the selling departments, and many of the newer firms, as you put it, are paying as much attention to the departments dealing with the sales generally, as they are to the actual manufacture of the goods.

I am assuming that the manufacturing department, with its shops laid out and run on modern lines, is producing

sufficiently cheaply for the open market to enable the commercial side of the house to sell in competition, for without this a selling department, however well organised, however capable its officers, would be unavailing.

A properly equipped organisation, actively canvassing for business, naturally costs money, and unfortunately economy sometimes is made at the expense of efficiency. That is, however, a very false economy. Very necessary, for example, in a commercial firm engaged in the manufacture of dynamos and motors is an advisory staff such as your article suggests. There should certainly be those with full practical and technical knowledge whose duty it is to advise the intending purchaser in reference to the machine required for a particular purpose, to point out the advantages of one type of machine as compared with another. But I question if, as you remark, purchasers would expect to pay for this advice in return for any benefit they would derive. Indirectly, the supplier would benefit, for while the expense that such a staff would involve would add to the cost of sale the customer—other things being equal—would naturally give the preference to the firm assisting him with such advice rather than to the firm who does not.

But while a properly equipped organisation makes it essential to have such a staff there are other features of the commercial side which demand attention, and if space will permit I propose to indicate these briefly.

There should undoubtedly be in every large manufacturing firm what for the sake of a better title might be described as a pioneer branch, a creative department, suggesting from time to time new articles for the market, and directing its ingenuity to improving designs. This might be considered as belonging more properly to the works, though in that case such a department would necessarily be closely allied to the selling part of the concern. This as part of a business system and organisation is one upon which I might say a good deal, but considerations of space compel me to simply mention it.

It goes without saying that a *sine quâ non* to a large turnover is an effective supply department with an efficient system of distribution, but the cost of this should be kept within limits.

Then a great factor is advertising, which is one of the numerous ways of the American manufacturer in finding a market for the product of the workshop. This is not valued sufficiently over here.

The importance of advertising cannot be over-estimated. Rather advertise, I say, too much than too little. But there is all the difference in the world between a policy prodigally extravagant, advertising by fits and starts without rhyme or reason, and a clearly defined system of judicious outlay in advertising.

The point I want to bring out is that no business can succeed without advertising. There are those who think that advertising is an extravagance. The idea is an erroneous one, and the firm which is guided in its policy by such an idea will sooner or later realise it to its cost. This is not the place to say how to do it, when to do it, or how not to do it. There are certain goods in which there is keen competition, that must depend upon continued publicity for continued sale. Have not many firms actually proved by experience in advertising a speciality that when the advertising expenditure has been curtailed, sales have dropped correspondingly?

But beyond emphasising the importance of advertising little more can be said here. Advertising is a business in itself, and this, too, in a large undertaking involves an efficient staff.

Cataloguing, as distinct from advertising, must also find an important place, for it is well known that the catalogue has made some of our modern firms.

A great deal more might be said with advantage. "Facts," says Emerson, "are in the saddle and ride mankind," and one thing is certain that only those firms who attend to the selling side of their business in these times of competition, and cultivate it, can hope for a ready sale for their products.

I will end as I began, and say that the subject opens up a fertile field for suggestion.

W. Young.

Ponder's End, *September 8th*, 1902.

Transmission of Electrical Disturbance.

In reply to Mr. R. Kennedy's letter in your issue of the 5th inst., I purposely abstained from going into the question of the possibility of explaining the transmission of etheric signals, over the distances hitherto achieved, by the diffraction of the electric waves. Theoretically the problem may be stated as follows:—

Given an etheric distance at a certain point of the earth's surface, consisting of waves of given length polarised in the plane of the horizon, that is to say, with the direction of the electric vibration perpendicular to the plane of the horizon, to determine the amount of disturbance at any point of the earth's surface, assumed for simplicity to be a smooth sphere.—There is no doubt that theoretically there will be a resulting disturbance at any such point, but whether, in the case of the Poldhu experiments, the disturbance so produced would be sufficient, with the power employed, to affect the coherer at the distances attained by Mr. Marconi is a question depending on the power employed, and on the disturbance required to operate the coherer, and at present I have no data at my disposal for attacking the problem.

If I am in a position later on to say something definite on the matter, I will, with your permission, send you a contribution. In the meantime I thought it might be of interest to point out the incorrectness of Mr. Kennedy's assumption that the problem would be rendered easier by assuming the disturbances to be atmospheric. Quite independently of there being, as far as I am aware, absolutely no facts whatever which would even suggest the possibility of atmospheric waves affecting the coherer, a very much larger amount of energy would be required, as a much larger proportion of the wave energy is dissipated into heat in the case of atmospheric waves than in the case of ether waves.

In Mr. Kennedy's letter of your issue of the 12th inst., he suggests the example of a transmitting wire 1,000 ft. high radiating waves 10 ft. long; the waves in this case, instead of being 10 ft. long, would be 4,000 ft., which is very much longer than that of any sound waves, with a corresponding increase in the amount of diffraction.

G. W. de Tunzelmann.

Electric Hoists.

I have, as electrical engineer for a North country firm, been experimenting for six months with a small electric hoist. This hoist is worked by a 1 H.P. motor, geared by means of a worm which drives a winding drum. The hoist has a run of about 15 ft., and is used for carrying a page of type from a linotype room in a newspaper office to the floor below, and *vice versâ*. In order that this should be satisfactorily accomplished, the hoist must come down dead against two iron stops at the bottom, and ascend to similar stops at the top, either with or without the page of type. The page of type weighs about 56 lbs.

To make myself thoroughly clear on this point, I might say that the page of type is slid from the planed metal surface of the hoist on to a planed cast-iron table, and *vice versâ*. For this purpose it is absolutely essential that the hoist should descend to a dead level with the table, and ascend equally accurately to a similar table above, either at full load or no load.

The enclosed sketch will give you the general working details of the hoist. So far my difficulty has been in obtaining the necessary accuracy of level between the hoist and the table, on account of the variation in load.

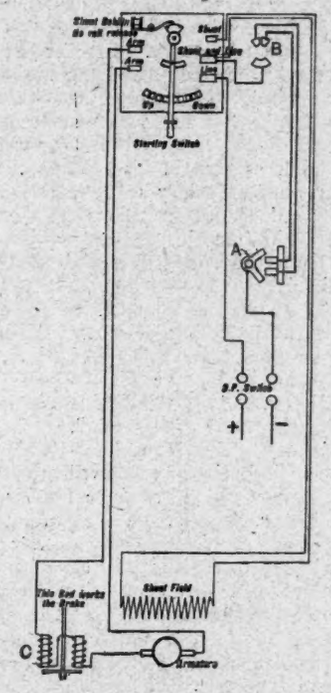
You will see on the accompanying sketch at the point marked A, that I have an automatic two-way switch. This is worked by two adjustable strikers, one on the balance weight and the other on the table. This two-way switch works in conjunction with another two-way switch at B, which is turned over by hand to start the hoist in the reverse direction after the hoist has ascended or descended. In the armature circuit of the motor there is an automatic electro-magnetic brake at C. When the current is on, the solenoid lifts the brake off a pulley fixed on the motor shaft. This allows the motor to run free, and the brake continues to remain off until the hoist arrives at the end of its travel. It thus automatically switches off at A, the brake falls on the

pulley of the motor and stops it almost simultaneously with the hoist's arrival at the iron stops.

To better this arrangement, two air cushions have been fixed at the top and bottom, and these help to lessen the jar caused by the hoist coming too violently against the iron stops.

I think I have now put you in possession of the general facts, but in order that you should thoroughly understand the trouble that ensues it will be necessary to give you a few figures :—

I.—In the first place the balance weight is heavier than the hoist, so that the hoist in ascending *empty* will go up of its own weight, and take very little current. This will, of course, cause the magnetic brake to hunt slightly, as only a



small current passing through the solenoid is not sufficient to lift the brake clear of the pulley. The brake, therefore, obliges the motor to take more current, this lifts the brake, but only for a short period, after which it falls again, and this process is repeated till the hoist arrives at the top.

II.—We will now take the case of the hoist rising to the top *with a page of type*. Under these conditions the hoist will be considerably heavier than the balance weight, and in order to drive the motor the current required will be about 3·5 amperes. This is amply sufficient to keep the brake entirely in the "off" position. In this case it is possible to adjust the strikers so that they always work the same. Under the former conditions (I) this is not possible, the reason being that if the brake has just fallen it somewhat checks the speed of the motor, and possibly before it lifts again the current may be cut off, and the hoist will come to a standstill short of the stops. In descending, the same conditions apply :—

III.—The hoist descending *empty* requires to be pulled down, and takes about 3 amperes.

IV.—The hoist descending *with a page of type*, falls of its own weight, and the hunting again ensues.

In spite of the above difficulties, we have by means of a light permanent brake, been able to obtain somewhat better running, which is only what might have been expected, the reason being that the striker can be set to knock off the current about half an inch from the top, and the brake, being actually on at the time that the current is cut off, stops the hoist at almost identically the same level at all loads. This last arrangement is not, however, perfect, and is objected to by the consulting engineer on the score of a waste of power. He also considers that the magnetic brake, being his idea, could be made to work perfectly, at the same time omitting to point out how the running of the same may be obtained.

If any of your readers are able to suggest any methods of improvement, I should be glad to read of them in your columns.

J. G. Y. D. M.

ELECTRICAL PATENT CASES, 1901—1902.

In the legal year which has now closed there have been several patent cases before the Courts closely connected with the electrical industry. A patent case is, to some people, a very dry and uninteresting affair, but this is a very erroneous view to take. Leaving out of consideration the parties fighting the action, who must obviously be keenly interested, as the result, one way or the other, may have important consequences for them and for their businesses, we may show that everyone connected with the electrical industry, or interested in the applications of electrical science, will find it profitable to follow intelligently the proceedings in these cases. Engineers are not always familiar with the history of the different branches of the science, yet a knowledge of this history is of great value, as it enables the student to understand each step of progress that has been made, and fixes his ideas on the subject. Now an important patent case almost always reveals the history of the particular subject discussed, for the defendants set up as anticipations earlier specifications, revealing, it may be, the nucleus of the later invention without its details, or, at any rate, showing what had already been achieved in the field which the plaintiffs desired to cover by their patent. Thus there is usually something *electrical* to be learned, quite apart from the legal aspect of the questions at issue, which may only interest lawyers. In what follows, we propose to give a short description of the electrical patent cases of the legal session, 1901—1902, not entering into detail on any one case, as full reports may be found in our columns for the past year, but treating them generally, and summarising the results of the year's litigation.

Meters.—In various departments of the industry has litigation arisen. We have had actions about meters, dry cells, electrolytic apparatus, rail-bonds, and fuse-boxes. The meter actions were the most important, and we shall therefore deal with them first. In Chamberlain & Hookham *v.* Bradford Corporation (see Electrical Review, November 22nd to December 6th, 1901) the defendant Corporation was charged with infringing the patent for the Hookham meter by using the British Thomson-Houston meter on its supply system. The first trial came on before Mr. Justice Farwell in the session 1900—1901, and was decided in favour of defendants on the ground of non-infringement. The case was then transferred to the Court of Appeal, and it is this trial with which we are concerned. The case was interesting in that the plaintiffs were allowed to bring additional evidence at the second trial, and in some respects it was amusing, as some of the learned counsel seem in this case to have got slightly "out of their depth" in dealing with the electrical principles involved in a motor meter with eddy-current brake, and were thereby led to make somewhat extraordinary statements. Take, for example, the following quotation from the speech of a learned K.C. on behalf of the plaintiffs, as it was reported in our columns. He was discussing the distinction between a current meter and an energy meter.

"It was obvious to everybody that if you had one of your forces constant, that is, one of the two forces that produced rotation—there were two fields, the armature field and the magnetic field—the way in which the rotation was got was by the inter-action of these two lines of force which went in opposite directions and produced a torque, making the thing go round. That field was only produced by current and not by pressure. The voltage had no effect upon the field. The only way by which the magnetic field was produced was by the flow of current along a wire or in a magnet, so that in one of those inter-acting parts you had current flowing, and in the other inter-acting parts you had what was called a shunt current passing. It was quite obvious that if one of those parts was functionally constant, that is to say, con-

stant because the machine made it a constant factor, whatever the current that went through it you would get one variant multiplied by one constant. That could only give you current, because energy was the multiplication of current by pressure. If you wanted to get at that, this being on the assumption that you wanted to measure variation of energy, and these being variants, you must have both interacting parts of your machine—parts which would interact—as two variants, and not one as a constant and one as a variant. That was an energy measurer. 'Now, then,' said his learned friend, 'our meter is just the same; if you put our meter on a circuit, a constant field is destructive.' If their Lordships would excuse him putting it in that way, it was dreadful nonsense."

Yes, it is dreadful nonsense, and we are not surprised to find Lord Justice Romer beginning his judgment with these words:—"This case has been argued by the learned counsel on behalf of the plaintiffs at great length and with much detail; the effect of their discussion of minute points arising in the case, coupled with the many difficulties involved in their elaborate consideration of electrical and magnetic laws, has been, in our opinion, somewhat to obscure an otherwise fairly simple and intelligible case." In fairness to counsel, however, we must admit that we do not often find them as much at sea as in this instance. Some of them have a sound knowledge of electricity, both in theory and practice, and in most cases there is little to find fault with in their technical explanations to the Bench.

The plaintiffs' line of argument was that Hookham had invented a type of magnet, practically permanent, having large polar surfaces closely fronting each other so as to form a narrow slit in which the eddy-current disc revolves, and that he was entitled to a broad claim to *every* permanent magnet of this type used in this way. The defendants' contention, on the other hand, was that Hookham's claim, if valid at all, was limited to compound or built-up magnets, which were not used by defendants. This contention was upheld by the judges of the Court of Appeal, who thus simply confirmed Mr. Justice Farwell's decision, without giving any judgment on the validity of the Hookham patent. They asserted, however, that if the wide interpretation was to be put upon Hookham's claim in this respect, it would be difficult to maintain its validity, in view of the writings of Marcel Deprez put in by defendants.

The other meter case was that of Ferranti *v.* British Thomson-Houston Company, the hearing of which extended from November 13th to November 18th, 1901. The question of the distinction between an energy meter and a current meter was again raised in this case, and the learned judge in fact based his decision upon this distinction, quoting, in this connection, some expressions used by Mr. Ferranti himself in an earlier case. "You cannot," said Mr. Ferranti on that occasion, "make an energy meter into a current meter. It will not register current. You cannot prevent it from being a true measurer of the energy—a very big distinction indeed." The Ferranti and Thomson-Houston types of meter are too well known to require explanation here, and, for the purposes of this case, what is specially to be kept in mind is the different arrangement of the starting coils in the two meters. The first type is a quantity meter, and has its starting coil in series with the main current; the second is an energy meter, and has its starting coil in series with the armature coil, which is a shunt across the mains. The learned judge, Mr. Justice Swinfen Eady, held that there was no infringement, so that it was not necessary to pass judgment on the further question of the validity of the Ferranti patent. Thus in one year the Thomson-Houston meter has successfully resisted two attempts to bring it within the ambit of patents for other types of meter.

Dry Cells.—In the case of Patent Exploitation, Limited, *v.* Siemens Bros. & Co., Limited, we have a trial of a somewhat different kind. Here there was practically an admission of infringement, and the real issue was the novelty of the invention claimed by the plaintiffs. The invention was described in the specification of Hitchcock's Patent, No. 1,110, 1890, for "an improvement in galvanic batteries." It was claimed that, although the principles involved in galvanic batteries were well known in 1890, the patentee had made an invention in applying those principles in a particular and effective manner, resulting in the production of a dry cell, which was a great improvement on what had hitherto been made. In this battery, according to plaintiffs' argument, the liquid element is removed and replaced by an excitant in the form of a paste stiff enough to keep its position and damp enough not to shrink; and, secondly, there is a two-layer element, the inner layer having an excitant which conduces to conductivity. The depolariser must not diffuse through the excitant, and it must be *pulverised*, as in a fine dust there is a large surface exposed and the hydrogen gas is more fully taken up. Mr. Justice Buckley in his judgment traced the earlier history of the subject, and found that the only points of novelty which could be pointed to were—(1) the absence of diaphragm between the two pastes—if that were a novelty; and (2) that the depolarising layer was to be made of materials capable of being, and which were, pulverised. On the first point, he held that there was no novelty, as earlier patentees had abolished the diaphragm, and indeed the evidence showed that this was a point of no substantial importance; and as to the second point, he found that the patentee neither told the world in his specification that pulverisation was necessary, nor did he claim it as part of his invention. The claim appeared to Mr. Justice Buckley to be much too wide, and he therefore declared against the validity of the patent for want of novelty. We have in this case another example of the necessity for a patentee to take the greatest care in formulating his claims. It was admitted that the dry cell of the plaintiffs was very useful, and that there had been large sales; but utility is not of itself sufficient, and by claiming more than the patentee was entitled to, the patent rights have been lost. Had the decision been in favour of the plaintiffs, Messrs. Siemens would have been heavy losers, as their dry cells also are in great demand.

Electro-plating.—The next case does not call for lengthy notice, as the electrical principles involved are well known. This was the case of the Electrolytic Plating Apparatus Company, Limited, *v.* Holland, and its main interest lies in the fact that the defence raised the question of "prior user." It was alleged by the defendants that an apparatus similar to that of plaintiffs had been used before the date of the patent sued on, for coating rifle bullets with nickel. This was not denied by the plaintiffs, who, however, asserted that it was merely an experimental user, and that there had been no publication to the world. This apparatus had been used in a room to which the public might have obtained access, but they had no business there, and no one was called to give evidence that he ever was there. The person who had made and used the apparatus gave evidence, and so did some of his employés, who had learned of the apparatus in their capacity as servants of the experimenter. Mr. Justice Ridley held that this did not amount to prior public user, such as could rob the plaintiffs' patent of its validity.

Rail Bonds.—In W. T. Glover & Co., Limited, *v.* American Steel and Wire Company, the plaintiffs, as assignees of Edmunds's Patent, No. 3,119, 1893, for "Improvements in the formation of solid ends on flexible or compound electrical conductors," sued the defendants for infringement of this patent by manufacturing rail bonds. The plaintiffs' copper bond is produced by "burning on"—that is, the ends of the wires or strips of the conductor are placed in a mould of the form and size which the solid ends are to have; hot copper is then run into the mould, and run out again through an outlet hole, thus removing the "chill" from the wire. The outlet hole is then closed, the mould filled, and fusion takes place between the ends of the wire and the terminal. The defendants maintained that their process of manufacture was quite distinct, as they forged their terminals out of a cylindrical piece of rolled copper, and the junction was made by welding. Mr. Justice Farwell could see no sort of invention at all in the process covered by plaintiffs' patent, as all the steps were well known at the date of the patent, and with reference to the infringement he said, "Welding as applied to copper was unknown at the date of this patent. What the defendants do is to weld."

Electric Furnace.—The chief interest in the case of Acetylene Illuminating Company, Limited, *v.* United Alkali Company, Limited, does not lie in the application of electricity to the manufacture of calcium carbide, but in a purely

technical point in the law of patents, which was incidentally raised. It will be remembered that under Section 103 of the Patents Acts, 1883—1888, an inventor who has taken out a patent in America or other foreign country may apply for an English patent under this section within seven months, and he will thereby obtain priority over any similar inventions patented in England during the interval between the grant of the foreign patent, and that of the English patent. In this case Willson's patent for the manufacture of calcium carbide was taken out in this country more than seven months after his American patent, and not under Section 103. In the interval Moissan had published a paper in this country, on which the defendants wished to rely as an anticipation of Willson's invention. The Court held that they were entitled to do so, as Willson's patent was not protected under Section 103, application having to be made under that rule within seven months. The electrical part of the case concerned the types of furnace used by the two litigants. Willson in his specification said he employed a suitable electric furnace "such as a Siemens arc furnace." The defendants used not an arc but an incandescent furnace, and the learned judge found there was no infringement, and that in view of Moissan's publications plaintiffs' patent was invalid.

Fuse Boxes.—Our last case refers to fuse boxes, and is an interesting example of a very "thin" patent being upheld by the Court. The Reason Manufacturing Company sued Ernest F. Moy, Limited, for infringement of their patent for "Improvements in fuse boxes for electricity supply mains." The invention consists simply in arranging the covers of a pair of fuse boxes, placed side by side, so that when one is open the other must be shut—in short, a simple interlocking device. The defendants alleged want of novelty, want of utility and want of subject-matter, and they relied on the user of interlocking apparatus in signals, &c., and on the common knowledge that in certain positions doors interfered with one another in opening. It was undoubtedly a case where the subject matter for invention was very "thin," although with regard to the statement about doors given above, it might certainly be said in the patentee's favour that people usually try to *avoid* having their doors so placed as to interfere with one another, and that he had turned to account what was under other circumstances a nuisance. The Court upheld the patent, finding that there *was* invention, though certainly not great, and though it might strike one as "just one of those things any fellow might have thought of."

This completes our survey of the year's electrical patent litigation. It will be seen that, on the whole, it has been a bad year for plaintiffs in actions, as in the majority of cases defendants have been successful. For some of the plaintiffs, however, matters are not so bad as they might have been, as although they have not succeeded in proving infringement, they have not had their patents declared invalid. No doubt we will hear again of some of these cases, as they will be taken to the higher Courts. In an important patent case it is very seldom that the parties rest satisfied with the decision of the Court of first instance, and it is very common to find them going to the House of Lords. No doubt they only stop at that point because they can go no further.

RE-HEATING OF INTERMEDIATE RECEIVERS.

Prof. Weighton has done a good deal of experimental work with the engines at the Durham College of Science, and, so long as it is remembered that his conclusions are drawn from results given by a certain engine, his experiments are of considerable interest.

His engine is a quadruple expansion engine, but in these trials the first and third cylinders were not used. The working cylinders were of a diameter of 7 in. and 15½ in. by 18 in. stroke, and a heater of 30 sq. ft. of tube surface was employed, steam of boiler pressure being admitted inside the coil. The only difference in the trials was the use of steam in the coil or its disuse, and ten trials were made in all, being five with re-heater steam and five without, at powers of from about 24 to 126 B.H.P. In every case the total steam consumption per B.H.P.-hour was less by about half a pound without the re-heater. At the same time, the re-heater gave from 3 to nearly 6 B.H.P. extra power with the same cut off, the engine running from seven to nearly three revolutions per minute faster. But the total condensation of steam in the re-heater coils was greater than the condensation in the receiver, which it was designed to prevent, and the condensation in the receiver was only about halved. Thus the total condensation with re-heater coil in use was very much greater than without steam in the coil.

The total water per hour was greater in every case with the steam in the coil, and the mechanical efficiency of the engine was in every case less by about 2 per cent., a result that seems rightly attributable to the friction of the L.P.-piston when running drier. If this be so, one is inclined to ask whether the lubrication should not rightly have been improved, and whether, with superheated steam, there is not considerable loss due to friction.

Thermo-dynamics may not have much to do with the economy of the steam engine, but it does point to its being wrong to add heat to the working fluid at any temperature less than the maximum.

It has long been gravely doubted by practical steam engineers whether jackets on the L.P. cylinder are not worse than useless.

In these trials the engine ran as it pleased, with a fixed cut-off, and as the re-heater added to the mean pressure and speed of the engine, this was enabled to swallow so many more charges of steam. We should have liked to see the engine run more nearly under actual conditions—that is, with the governor in gear, so that the normal speed would have been attained more nearly, or even exactly, had a supplementary governor been in use. It is not really a practical test to endeavour to find the effect of a re-heater with a fixed cut-off.

The tests show one thing, namely, that by adding heat at a very unfavourable point, an engine will run faster, will secure a higher mean pressure, and will do more actual work in B.H.P., even if at less mechanical efficiency. This may be the Professor's idea of running a test under identical conditions, but we venture to suggest that practical conditions have not been met, and it is possible that different conclusions might have been drawn, though the difference would, perhaps, have been trivial. Still, they would have shown more accurately what might be expected in actual practice.

The steam per I.H.P.-hour showed very little difference in any case, and at the lowest power, was actually a trifle less with steam in the heater coil, but generally it may perhaps be fairly concluded that re-heaters are not worth their money.

The vacuum was kept as nearly constant as possible in each pair of trials, but no further information is given on this point.

Experimental engines are not always built on practical lines. There are several American engines at work in this country that have re-heaters. The Allis engines at Glasgow tramway power station have them, and so have the Musgrave engines, but of a different type. It would be of interest to have it ascertained if any or all of the apparently higher economy of the American engines could be explained as an effect of re-heating on better lines.

The Durham College engines are very small, and it remains to be seen whether large engines would obey the same rules, as upon this would depend whether the latter could be made still more economical by adding to them re-heaters, when these have not been fitted, and *vice versâ*.

The general table of results in the paper seems to us to point to the benefits of draining between cylinders rather than re-heating. Considering that even with re-heaters the indicator cards showed from 30 to 40 per cent. of water at cut-off in the L.P. cylinder, we confess to being a little puzzled by the loss of mechanical efficiency. The tests are interesting, if a trifle inconclusive.

LEGAL.

In re Mazarron Electric Light Company, Limited, (Richard v. the Company).

In the High Court of Justice on Wednesday, September 17th, the above matter came on before Mr. Justice Swinfen Eady, sitting as Vacation Judge. This was a motion by the plaintiff, Richard, a debenture holder, and also a judgment creditor of the company, for the appointment of a receiver and manager, and also for an account.

Mr. Robertson appeared for the plaintiff, and Mr. G. E. Tyrrell for the company.

Mr Robertson said the plaintiff was the holder of five debentures of £20 each in the defendant company, which was incorporated in 1893 for the purpose of establishing a system of electric lighting for the town of Mazarron, in Spain, under a concession dated September 6th, 1892, for 50 years, and the company was now working that concession. About the same time the company issued a series of debentures—250 first mortgage debentures of £20 each—of which the plaintiff held five. By the conditions endorsed on the debentures the company was to redeem at par an aggregate amount of at least £900 on January 1st, 1899, and every succeeding January 1st. The principal moneys were to become payable in full in the event of the company being in default of payment of interest for a period of six months, or an order being made for compulsory winding-up. The evidence was that the defendants had committed a breach of the conditions in that it did not redeem in 1902, or at all, debentures to the extent of £200, and the plaintiff asked for the appointment of a receiver and manager.

Mr. Tyrrell submitted that the appointment asked for was unnecessary and inexpedient, and said that in December, 1901, the plaintiff, who had been the secretary, was dismissed by the directors.

His Lordship said that Richard was an unsatisfied judgment creditor.

Counsel submitted that had nothing to do with the present application. Plaintiff had been paid the whole of his interest; he made no application to the company, but simply started his action.

His Lordship said there must be the ordinary order referring the matter to Chambers for the appointment of a receiver and manager.

Mr. Robertson asked that the receiver might be appointed to act forthwith, because if the company were in default in supplying light for 10 days, the whole concession went, and the substratum of the company would be lost. He wanted the receiver to telegraph out at once to a servant of the company in Spain intimating his appointment by the Court, so that arrangements could be made for the continuance of the electric light supply.

His Lordship said he would appoint Mr. Hussey as receiver and manager, and for any directions he required he could apply at once to a judge in Chambers, no notice being necessary for that.

Re British Power, Traction and Lighting Co., Ltd. (Petition of L. Hannen).

In the High Court of Justice on Wednesday, 17th inst., the above matter, which was an application by a creditor for an order for the compulsory winding up of the company, came on before Mr. Justice Swinfen Eady sitting as Vacation Judge.

Dr. Napier said a petitioner was a creditor for £250. On the previous afternoon five affidavits had been served, and in order to answer these he (counsel) had to apply that the petition should stand over for a week.

Mr. Kenyon Parker said he appeared for the company, and he asked that the petition should stand over for two months, in consequence of a resolution which had been unanimously passed at a meeting of shareholders, of which all the shareholders had notice.

Dr. Napier said it was precisely on these facts that he applied that the matter should stand over.

Mr. Kenyon Parker said there had also been a creditors' meeting, at which the facts were put forward, and it was pointed out that unless fresh capital could be secured the company must stop. A resolution was put to the meeting that the matter should stand over.

His Lordship asked if the petitioner had had an opportunity of meeting these affidavits?

Mr. Kenyon Parker said he could not tell that.

Mr. Bramwell Davis, K.C., said the affidavits were filed two days ago.

His Lordship said that if the application that the petition should stand over for two months depended upon these new affidavits, he could not act upon it, as the petitioner had had no opportunity of meeting them. The matter must stand over for a week.

Subsequently, Dr. Napier intimated that he and the other side had arranged that the petition should stand over until the first petition day after November 17th.

Re The Universal Microphone Company, Limited, *v.* Nye and Another.

In the High Court of Justice on Wednesday, the 17th inst., there stood in the list for hearing before Mr. Swinfen Eady, Vacation Judge, two motions as above, by the plaintiff company asking for injunctions against the defendants to restrain them from assigning patents.

Mr. Houston, who appeared for the applicants, said the defendants had filed affidavits though they did not appear, and they had undertaken meanwhile not to deal with the patents which were the subject of the action; and that being so, he (counsel) was willing that the motions should stand over for a week.

His Lordship assented.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Sept. 17th, 1901.		Week ending Sept. 16th, 1902.	
Aden. Teleg. mat.	Value £56	Alexandria	£49
Amsterdam	185	Amsterdam	168
Beira. Teleg. mat.	103	Bombay	20
Bombay	49	,, Teleg. wire	710
Brussels	120	Buenos Ayres	439
Buenos Ayres	619	Calcutta	563
,, Teleg. cable	744	Cape Town. Teleg. mat.	856
,, Teleg. mat.	105	Channel Islands	317
Calcutta	4,324	Christchurch	55
,, Teleg. wire	208	Colombo	108
Cape Town	2,786	Durban	469
,, Teleg. instruments	695	,, Teleg mat.	3,156
Chinde	96	East London	1,241
,, Teleg. cable	511	Flushing	22
Christiania	177	Gothenburg. Teleph. cable	319
,, Teleg. wire	70	Hamburg. Teleg. mat.	800
Colombo	55	Melbourne	166
Copenhagen. Teleg. wire	56	New York	105
Delagoa Bay	40	North Atlantic. Teleg. cable	2,500
Durban	515	Oporto	70
East London	48	Otago	24
,, Teleg. mat.	231	Port Elizabeth	85
Hamburg. Teleg. mat.	200	Shanghai	400
Hong Kong	21	Stockholm	78
Karachi. Teleg. mat.	665	,, Teleph. cable	161
Lyttleton	35	Sydney	857
Melbourne	181	Yokohama	3,815
Port Elizabeth	17		
Rio Janeiro	68		
Rosario	45		
Rotterdam. Teleg. wire	19		
Shanghai	151		
Singapore	72		
Stockholm. Teleg. wire	76		
Sydney	486		
Tokio	186		
Wellington	88		
Yokohama	709		
Total	£14,712	Total	£16,927

Foreign Goods Transhipped.

Calcutta. Elec. parts	Value £64	Gothenburg. Elec. apps.	Value £206
Durban. Teleph. wire	76		
Perth. Elec. supplies	85		
Total	£175		

Patent Amendment Abroad.—Messrs. Edward Evans and Co., consulting engineers and patent agents, of 27, Chancery Lane, W.C., write to us as follows:—

It will be of considerable interest to manufacturers to know that on September 14th amendments of importance will take effect in all the States of the Convention, that is to say, in Belgium, Denmark, France, Italy, Japan, Netherlands, Norway, Portugal, Sweden, Switzerland, Tunis and United States.

The principal amendments taking effect are as follows:—

(*a*) The priority granted to applicants for patents, designs, or trade marks, in any of the States of the Convention shall be 12 *months* for patents, and 4 *months* for designs or trade marks, reckoned from the date of the application in the State in which the applicant is domiciled.

(*b*) The patents applied for in any of the States of the Convention by persons entitled to the privileges thereof shall be independent in duration of patents obtained for the same invention in other States, whether parties to the Convention or not.

(*c*) No patent applied for under the Convention shall incur forfeiture for non-working until the expiration of a minimum period of three years from the date of application.

The extended period of priority given to applicants under the Convention has been granted in Great Britain since January 1st, 1902, by the amending Act that came into force on that date.

Premier Gas Engines.—Commenting with approval on our leader on "British Power" of last week, Mr. J. H. Hamilton, of the Premier Gas Engine Company, Limited, writes:—"It may interest you to hear that besides the 250-H.P. gas engines of our make which you describe in the same number, in connection with Messrs. Smith, Parfrey & Co.'s works, we have supplied another of the same size for rope-driving a dynamo, which supplies current for motors in a factory; two of the same size direct coupled for motor-driving and electric lighting; a 600-I.H.P. engine for motor driving; two engines of 150 H.P., and one of 200 H.P., each direct coupled for motor driving in engineering works; and have in hand three engines of 150 H.P., and two of 250 H.P. direct coupled for motor driving and electric lighting, besides many engines of smaller sizes, direct coupled or driving by rope or belt. The above are all for running with producer gas, but we have three engines of 320 H.P. each in hand, to run on blast furnace gas and drive dynamos (by ropes) supplying current for electric light and power. All these engines are for English and Scotch firms, and we have not mentioned the numerous cases where our large engines are used for driving dynamos for electric lighting only, and for electrolytic work."

American Electrical Exports.—The exports of electrical machinery from the United States of America for the 12 months ending June, 1902, were valued at £5,379,746, as compared with £5,512,715 for the same period the previous year.

Preston Polyphase Machinery.—Messrs. Dick, Kerr and Co. have recently standardised a complete series of alternating current machinery, including three-phase generators and induction motors; but it must not be thought that their contracts for alternating machinery comprise only three-phase, for we learn that they are making a large two-phase generator for Fulham and single-phase alternators for the Bexley District Council. The stator frame is of cast-iron, built in two halves, which are securely bolted together. The frame is so designed as to permit complete ventilation of the laminations, while at the same time securing ample rigidity. The lower half of the frame is provided with feet, which rest upon the foundation bedplate. In the larger machines the

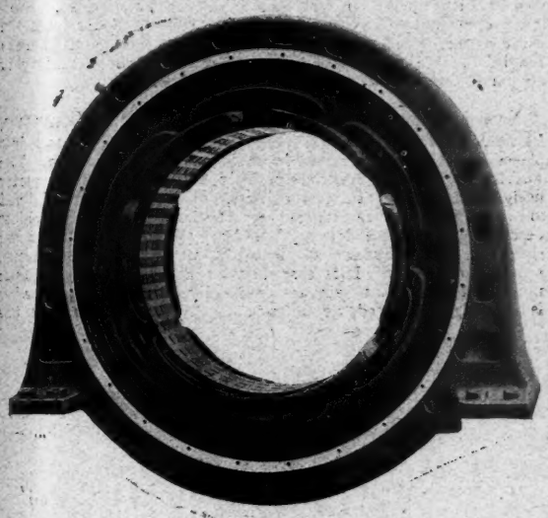


Fig. 1.

lower half is provided with a special screw, which will permit the stator frame to be racked over to such a position as to leave the rotor completely exposed. The stator core is made of thoroughly annealed soft iron laminations, well insulated from each other; the iron composing the laminations is of a special composition, which has been arrived at after a great number of experiments, one of its chief advantages being that it prevents any appreciable increase of the hysteresis losses after the machine has been running for some time. The laminations are held in position in the frame by means of bolts. The stator coils are former-wound, embedded in rectangular slots, and held in position by wooden wedges. The special arrangement of the connections between the stator coils permits of their being easily traced and located. The general design of the stator frame and its parts is shown in fig. 1. The coils are protected outside the laminations by means of a cast-iron shield, cast in sections and bolted to the frame, this being easily removable. The shield is perforated, so as not to interfere with the ventilation of the winding; it is shown in position in fig. 3. The

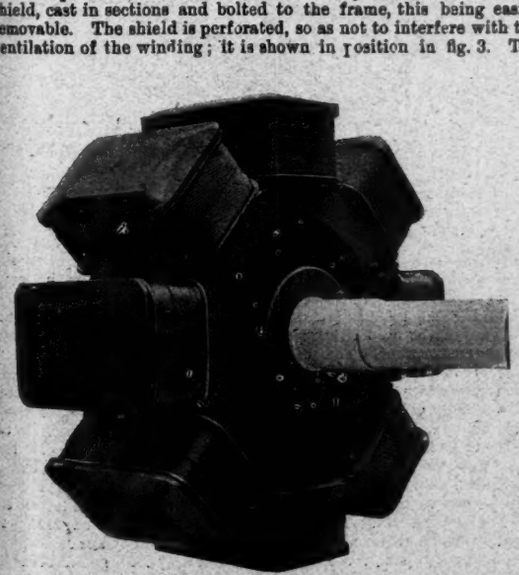


Fig. 2.

rotor spider is made of best quality cast-iron of strong and ample design; the hub is provided with a flange for bolting to the engine fly-wheel, and is accurately bored to gauge and key-seated. It is pressed on the shaft by hydraulic pressure. On the spider rim dovetailed laminations are secured by means of machined bolts and cast-iron flanges, and are then ready to receive the pole-pieces. Ventilating spaces are provided in the laminations and spider, thus permitting the maximum amount of cooling of the field coils. The rotor shown in fig. 2 differs slightly from the standard practice in that the coils are mounted on a steel rim. The pole-pieces are made of laminated steel, held together between two steel end plates. The upper part of the pole-piece is of a T-shaped construction, so designed to hold the field coils firmly in position. The lower part of the pole-piece is dovetailed for fixing on the rim of the rotor, and is held in position by means of keys. The removal of the field coils is effected by sliding the pole-pieces from the dovetailed groove parallel to the shaft, without disturbing any other part of the machine. The design and shape of the pole-piece, moreover, gives a distribution of the lines of force in the air gap, such as to produce an approximately sinusoidal E.M.F. wave. When the excitation voltage permits, the field coils are wound

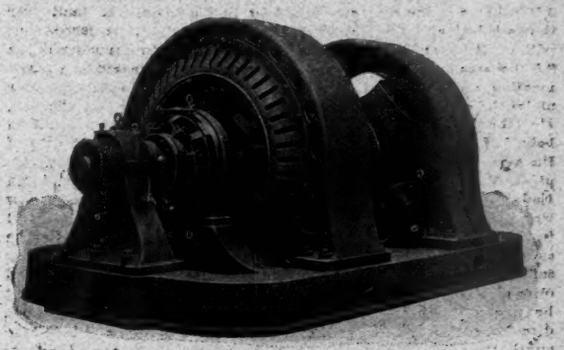


Fig. 3.

with a single layer of copper strip, wound edgewise, and insulated between the turns by means of a specially prepared fibrous insulation. The external surface of the windings is left bare, being protected by insulating varnish only, thus allowing a rapid cooling. In the testing of the machinery the field windings of the rotor are subjected to an insulation test of 2,500 volts alternating current between the coils and the frame. The windings of the stator are tested with from two to three times their normal voltage, according to the size and voltage of the machine. The portions of the machine illustrated herewith form one of a set of machines which are being made for the Portsmouth Corporation and the Horndean light railways. They comprise four motor-alternator sets, a complete view of one being given in fig. 3. Two of these sets will be placed in the generating station of the Portsmouth tramways, three-phase high-voltage current being transmitted to a sub-station on the Horndean light railway system. At this sub-station the alternating side of the combination will become the motor, continuous current being taken from the other end of the machine direct into the line. The effective capacity of this machine is 250 KW. Some recent tests made on these sets showed that the temperature rise after six hours' run was 39° F. on the stator core, and about 70° on the field.

Bright's Light and Power, Limited, v. Wingfield.—In the High Court of Justice on Wednesday, September 10th, Mr. Justice Swinfen Eady, sitting as Vacation Judge, delivered a considered judgment in the above matter. His Lordship said the motion in the matter was one on behalf of the Bright's Light and Power, Limited, for an order that the name of the plaintiff company might be struck out, an order made that the action should be stayed, and that the solicitors, Messrs. Marshall & Marshall, who issued the writ, should be made to pay all the costs of the proceedings. The short point involved in the motion was as follows:—The writ in the action was issued on August 6th, 1902, and the action was said to have been authorised to be brought at a board meeting at which there were present Mr. F. R. Bright, Mr. Vidal and Mr. Moreno, three persons claiming to be directors of the company, and alleging that they, together with a Mr. Otto Semmelhaack, constituted the only directors of the company. The validity of their appointment as directors was not seriously said to be established. It depended in the first instance upon a resolution purporting to be passed at a general meeting held on January 10th, 1902, which purported to remove from office the existing directors, except Mr. Moreno and Mr. Pollard (who appeared for the respondents to the motion) said that having regard to the fact that the meeting was out of time, and that it purported to pass an extraordinary resolution, whereas it was called for the purpose of passing a special resolution which ought to have been confirmed, and having regard to the evidence filed on behalf of the motion, he would not maintain that that meeting was valid. On the assumption that the meeting was regular, Mr. Moreno executed a deed, dated January 21st, 1902, reciting the extraordinary resolution purporting to have been passed at the meeting on January 10th, and that in pursuance of Article 6 of the company's articles, he (Mr. Moreno) being the sole director of the company in the exercise of his power as such, appointed Mr. F. R. Bright, Mr. Vidal and Mr. Otto Semmelhaack, additional directors in order to bring the number of the directorate up to four. It followed, his Lordship continued, from the fact that the meeting was irregular, and that no resolution passed at it was binding on

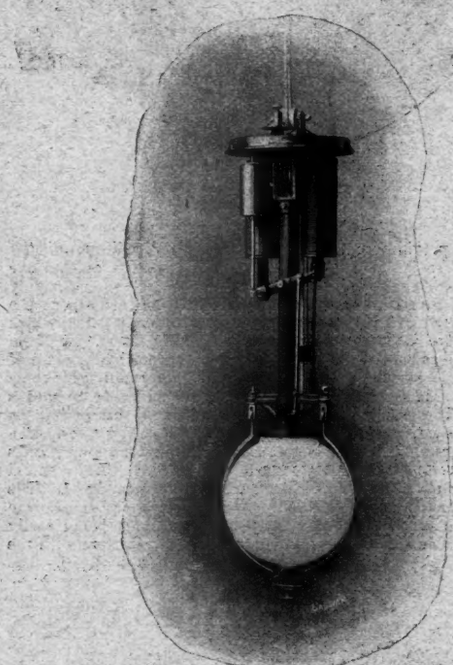
the company, that Mr. Moreno was not the sole director, and had not in point of fact the power which he purported to exercise under Article 76. Although it was in dispute who the other directors were at that date, it was not in dispute that Colonel Hayworth was one, and therefore when the deed was executed, Mr. Moreno was not the sole director. The result was that the so-called meeting authorising the bringing of the action, and attended by Mr. Bright, Mr. Vidal and Mr. Moreno, was not a lawful board meeting, and as regarded Bright and Vidal, they were not directors of the company at all. With respect to Mr. Moreno, there had been certain litigation to which that gentleman was a party, and on March 8th, 1902, an agreement in writing was entered into between Mr. Moreno and Mr. George C. Harrower, trustee of the property of Charles Bright, a bankrupt. The agreement provided, amongst other things, for a consent judgment in an action brought by the trustee against Moreno & Bright's Light and Power Company, Limited, with reference to certain shares, and it was one of the terms of the agreement that Mr. Moreno would immediately transfer 8,500 shares in the company standing in his name, and hand over the certificates to Mr. Harrower, the trustee, this to be carried out within 24 hours. Pursuant to that, Mr. Moreno transferred the 8,500 shares on March 8th, and the transfer was passed at a board meeting on the 12th. Mr. Moreno then ceased to be a director under the articles, having ceased to hold the necessary qualification. He (the judge) was aware that a contention was put forward on behalf of the respondents, that Mr. Moreno disputed the validity of the agreement, and either had instituted, or proposed to institute, proceedings to have it set aside. But he (Mr. Justice Swinfen Eady) had to deal with the legal position of the parties, as it now was, and certainly from March 12th. Mr. Moreno, *ipso facto*, ceased to be a director of the company. Whether he should hereafter be successful in setting aside the agreement, or in otherwise retaining sufficient shares to qualify him as a director, and he should be elected or re-elected as such, were matters which lay in the future. At present he was without any qualification whatever, and ceased to be a director, certainly as from March 12th, if not before, and therefore any board meeting at which he attended and authorised the issue of the writ in the action, would be irregular for the reasons stated. There were also present as directors passing the resolution, Mr. Thomas Blair, Mr. C. J. Wharton, and Mr. G. A. Wingfield, and he (the judge) had to consider whether those persons were authorised to pass such a resolution, and whether the meeting was, in fact, a valid board meeting. He was of opinion that Mr. Wharton, who had been the company's salaried engineer, was a director in August, 1902, and that Mr. Wingfield and Mr. Blair were also properly constituted directors. The conclusion to which he had come was that the motion to stay the action was authorized by a regular meeting of the directors, held by persons not only acting but, in fact, duly qualified as directors. He was desired not to make an order on the motion as desired by the parties moving, but to let the action continue, substituting the name of Mr. F. R. Bright. He was of opinion that that would be a wholly irregular proceeding, and that the proper order to make was to stay all further proceedings, to dismiss the action and to order that the costs of the company as between solicitor and client, and the costs of the defendants as between partner and partner should be paid by Messrs. Marshall & Marshall, the solicitors.

A Combination Fitting.—In the accompanying illustration we show a patent combination electric light fitting which is about to be placed upon the market by the "Emitevas" Electrical Fittings Company, of 31, Brooke Street, Holborn, E.C. Perhaps we ought to mention, by way of explanation, that you have to spell "Emitevas" backwards to get at the prime object of the

A Combination Fitting.

inventor of these fittings. The principle will commend itself to electrical contractors and the trade on account of its convenience, for, with a stock of the several parts, which, by the way, are all interchangeable, an endless variety of fittings may be constructed on demand, or the moment they are required for use. With the various sizes of electrolier bodies on hand, and a stock of arms, it is possible to make up in a few minutes, ready for fixing, fittings for from 2 to 12 lights.—The same arms are adaptable for oblique lights, cord suspension, or candle fittings, and, being fitted with one kind of universal slot joint, which is easily and firmly fixed by a screwed ring, the common defects of loose joints and stripped threads are avoided. The same arms and bodies may be used for electroliers, brackets, and for candelabra for dining table or sideboard lighting if fixed upon a pillar or tablestand, and they are thereby particularly adapted for temporary lighting purposes, and, as a good point in their favour for export purposes, we may mention the closeness with which they may be packed. The drop ornament of the bodies is, as we show, made removable, and contains a lamp-holder, so that an extra lamp may be added at any time, and a supply of current, by means of a flexible cord and a B.C. adaptor, may be made use of for fan, desk light, or other purposes. Insulated screw connectors are supplied to attach the wires from the various arms, by the use of which the wiring of the fittings is much simplified. We understand that the company has a variety of designs in preparation.

New Arc Lamp.—The New British Arc Lamp Company, Limited, of Horsell Road Works, Holloway Road, N., have just placed on the market an enclosed long-burning arc lamp. The workmanship and materials are entirely British, and with superior design and construction of the parts, perfect burning is claimed to be obtained. The lamps are of the smallest and lightest description, the overall length of the lamp not exceeding 2 ft. 2 in.; simplicity of construction and long life, averaging about 100 hours, are claimed for it. It is easy to trim, and having a minimum number of parts, the repairs are practically *nil*; noiseless running is claimed, and, indeed, we understand that, in order to hear the



The New British Arc Lamp.

lamp at all, the ear must be placed against the globe of the lamp. The ventilation is claimed to be such that heating has been practically eliminated. Numerous other advantages are claimed for the lamp, amongst them being a direct connection with the top carbon holder, combining mechanical stability with superior electrical design; the lamp can be used either for indoor or outdoor lighting, the case being weatherproof. The resistance coil has received special attention. It is claimed to be impossible for the coils to make contact upon themselves, or to cause a short circuit, each coil being placed in a deeply grooved porcelain separator, and these being fastened together by a patent arm device. The choking coil, which is the result of exhaustive experiments and long experience, is said to be most efficient. It is thoroughly laminated, and noiseless in operation. The trimming is easy, even for the most inexperienced person, and in the most inaccessible place, and the reflector can always be cleaned or replaced without taking the lamp from its position. The globes are of toughened and specially annealed glass, and shaped to stand the expansion necessary to avoid breakage from the heat of the arc. Mr. Charles Leven is the managing director of the company.

New Electrical Motor Cars.—Several new electrical motor cars are about to make their appearance. Mr. H. F. Joel, of Finsbury, is busily at work on a new model; the Anti-Vibration Company's Certus Works, of Croydon, are engaged on the construction of a new car, another one being in hand at the works of Messrs. C. Peacocke & Co., Clerkenwell.

Split Key-Holder.—The demand for reliable switch lampholders which shall be proof against short circuit at high voltages has led Messrs. Markt Bros. & Co., of 38 and 39, Beech Street, Barbican, to introduce into this country a lampholder specially designed to meet these requirements. The insulating body, of white porcelain, is a split cylinder, as shown in the accompanying figures; the switch, which is of the continuously rotatable type, is mounted in a little chamber inside the blocks, the contacts being of springy copper. The poles are separated by a partition of pressspahn, through which the stem of the switch handle

Fig. 1.

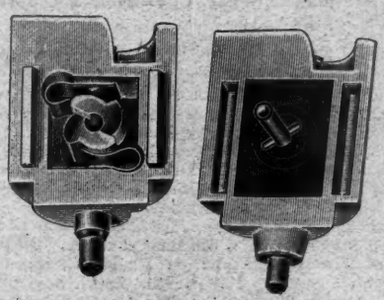


Fig. 2.

passes; the latter is completely insulated from the circuit The flexible leads are connected by means of screw terminals, which are situated in separate compartments in the base of the porcelain blocks; the partition between these is partly cut away on each half cylinder, so as to facilitate the wiring, while when the two parts are assembled the separation is complete. The base of one of the spring contacts is also surrounded with a ridge of porcelain, to prevent short-circuiting to the case or to the other contact. The complete holder is provided with cord grips and shade carrier, and certainly appears to combine the elements of simplicity and reliability.

Catalogues, Lists, &c.—The Nernst Electric Light, Ltd., of 82, Victoria Street, who are introducing the Nernst lamp into the territories for which they hold the sole rights, and which include the whole of Asia, Africa, Central and South America, and all British Colonies, have just issued a new illustrated catalogue and price list. This describes the two types of lamps which the company are prepared to sell. The lamps are rated by current, not as is usual with incandescent lamps, by candle-power. The candle-power therefore depends on the voltage of the supply, but as lamps are made for three different currents, viz., 0·25, 0·5, and 1·0 ampere, it is always possible to get a lamp very near to the particular candle-power required. The total range of candle-power is wide, extending from 15 to 170 candles; there are, therefore, lamps suitable for replacing single glow lamps, for replacing clusters, and for street and shop lighting in place of arc or incandescent gas lamps. The lamps are made for any voltage, from 100 to 250; the high voltage lamps are slightly superior in efficiency to those for lower voltages, and are just as good in respect of their life and maintenance of candle-power. An idea of the performance of the Nernst lamp may be gathered from the three life curves published in the catalogue. These show the results of tests of candle-power and efficiency of the ½, ¼, and 1-ampere lamps for high voltages. The candle-power is well kept up during the life, and the efficiency is high, the consumption of power being less than 2 watts per candle on the average. Some idea of the economy thus effected can be gained from the tables and information published on another page of the catalogue.

A small booklet has come to hand from Mr. W. Gyllich, of 10, Lloyd's Avenue, E.C., giving some details of the Titan electric lift, which is made by the Titan Company, Limited, whose head offices and works are at Copenhagen. All the electrical apparatus for operating the lift is mounted on the same bed-plate as the lifting gear, and there is no apparatus in the lift-well requiring attention. The special feature consists of the use of a series of push-buttons. By the lift door on each landing a button is placed, and inside the cage there is a series of buttons, one for each landing. By pressing a button outside a landing, the cage begins to travel, and stops automatically when it is opposite the landing door, which only then can be opened. After entering and pressing one of the buttons in the cage (the landing door shuts itself), it will move up or down, as desired, and stop where directed to, but it will only start if all the doors are closed; otherwise it will remain stationary. The push-button system can also be applied to a lift with an attendant, when, by turning a switch, the button starting system is converted into a call system in connection with an indicator inside the cage, showing the lift man at which landing the lift is wanted. It is also possible to connect the wires in such a manner that, on pressing the outside button when leaving the cage, it can be sent down to the ground floor ready for use again. This is done without introducing any new buttons, those already mentioned being sufficient for the purpose.

The Western Electric Company, of North Woolwich, have just issued an illustrated catalogue and price list of their telephones for private installations. These include wall, desk, and intercommunication sets, also parts, and some serviceable wiring diagrams.

Messrs. Richardsons, Westgarth & Co., Limited, of Middlesbrough, who have taken up the sole manufacturing agency for England and Wales for the Cockerill gas engines (Delamare-Debouteville and Cockerill patent "Simplex" system) for blast furnace gas, have brought out an illustrated list in which they give particulars of several blast furnace installations which have been put down. Three gas-driven blowing engines of 1,200 H.P. have been built for Volkirgen, and one of these and several others of 600 H.P. are shown in the pictures. It is interesting to note that the Cockerill Company are now building a "Simplex" gas engine of 2,500 H.P.

Messrs. Vandam, Marsh & Co., of Gerrard Street, W., have issued a catalogue of their electrical supplies. The first section, pp. 1 to 117, covers a host of switches, cut-outs, ceiling roses, fuse-boards, lamps, lampholders and shades, conduit wiring, &c.; the other section, which starts its numbering at 200 and continues to 328, contains illustrations of designs for electric light fittings, such as electroliers, pendants, ceiling fittings, brackets, and a good selection of figure standards and other floral fittings. The book is strongly bound in bright red covers.

A new list of enclosed continuous-current motors has been issued by the Fuller-Wenström Electrical Manufacturing Co., Ltd., whose works are stated to be now engaged manufacturing this type of motor on a very large scale with special machinery, and therefore at reduced prices.

September stock lists of continuous-current dynamos and motors have been brought out by Messrs. Royce, Ltd., of Manchester.

The Electrical Co., Ltd., has issued a new price list (illustrated) of its large switchboards and accessories therefor.

Lists of multiple band saws for steel or wood, and of rolled steel railway chairs, have come to hand from Mr. James Muirhead, of Cart Forge, Glasgow.

Books Received.—"Cassell's Cyclopædia of Mechanics," edited by P. N. Hasluck. London: Cassell & Co., Ltd., 1902.

"Our Empire," by Sir Guilford L. Molesworth. London: Ward, Lock & Co., Ltd., 1902. 1s.

"Subject List of Works on Domestic Economy, Foods and Beverages." London: Patent Office, 1902. 6d.

"Electro-Plating and Electro-Refining," being a new edition of A. Watt's "Electro-Deposition," by A. Philip. London: Crosby Lockwood & Son, 1902. 12s. 6d. net.

Trade Announcements.—Mr. Chas. Fredk. Green has retired from the firm of Messrs. C. Barker & Co., electrical engineers, of The Bittoms, Kingston-on-Thames. The business will be continued alone by his partner, Mr. James Henry Burt.

Messrs. Isaac Griffiths & Sons, manufacturers of enamelled steel conduit tubes and fittings, of the Imperial Tube Works, Wednesbury, have just appointed Messrs. Geo. Piggott & Co., of 110, Cannon Street, E.C., as their sole agents for London and district. Catalogues are being circulated, and one of the special features is that all the tubes and fittings are subjected to a high temperature enamelling inside and out, which imparts a good surface, and adds considerably to its preservative qualities.

We are informed that Messrs. W. T. Glover & Co., Limited, Manchester, have for the convenience of their customers in Ireland, made arrangements with Mr. F. A. Porter, 13, Queen's Square, Belfast, to keep a permanent stock of their vulcanised wires, cables and flexibles.

The Electrical Company, Limited, of Charing Cross Road, and the Allgemeine Electric Company, of Victoria Street, have amalgamated, and the joint business will be conducted under the name of the Electrical Company, Limited. Mr. Hadley, formerly manager of the Allgemeine Electric Company, has been appointed joint general manager of the Electrical Company, and will conduct the central station and tramway business, both at home and abroad.

The Langdon-Davies Electric Motor Co., Ltd., has altered its name to the Langdon-Davies Motor Co., Ltd.

Messrs. F. A. Glover & Co., Ltd., are removing from their present address in Queen Victoria Street to 10 and 12, Garrick Street, Strand, W.C.

Brighton.—The forthcoming Electrical Exhibition at the Aquarium promises to be a great success in every way. The entire main corridor of the institution will be occupied, all the available space, covering some 5,000 sq. ft., having been let. Altogether some 28 or 29 firms have taken spaces, and these represent the leading electrical concerns throughout the country. The exhibition, as at present contemplated, will begin on October 4th and terminate on the 18th of that month.

Westinghouse Works Power Equipment. — In further connection with the power equipment of the Westinghouse Works in Manchester, which formed the subject of an article in the Electrical Review last week, we learn that the generating plant at present in position only represents a portion of what it is intended shall be installed, and which will be required in the very near future. The capacity of the present plant is something over 3,000 H.P., and large as this appears to be, it is not nearly enough for the driving of the innumerable machines and devices of these gigantic works. The British Westinghouse Company will manufacture at their works in Manchester all the well-known types of Westinghouse engines, consisting of reciprocating steam engines of several forms, steam turbines, and gas engines. The first class is well represented in the four specimens of compound engines now installed; steam turbines and gas engines are to follow. The result will be a unique combination, and apart from the general interest which is bound to attach to a power station employing all modern types of primary power producers, the use of these for one common purpose will afford excellent opportunities for valuable comparisons, and the working results will be followed by engineers with interest. In choosing to instal steam engines first, the advisers of the company had in mind the urgent necessity of obtaining as soon as possible a preliminary power supply, and also the fact that steam was required for several works processes and for heating the buildings.

Imports of Foreign Electrical Plant.—August proved to be rather an active month as regards the importation of foreign electrical goods and apparatus into this country, the returns showing a total of £57,388, which compares with £51,868 in the preceding month and £42,096 in August, 1901. So far as the year has gone, however, there has been a further decline in such imports, the returns for the eight months ending with August last showing an aggregate of only £464,667, as against £637,169 in the corresponding period of last year, and £697,592 in the first eight months of 1900.

Gas-Driven Generators.—In the article on p. 442 of our last issue relating to a gas-driven set at the Cork Exhibition a slight error occurred. The illustration shown was that of one of the Lancashire Dynamo and Motor Company's generators coupled to a Stockport gas engine. The particular set shown was supplied to Messrs. Hodgson & Stead, the makers of weighing machinery, for the lighting and driving of their works. The Lancashire Company have made a speciality of direct-coupled gas engines sets, and are at the present time building a very large number, including four 250-H.P. generators for coupling to Crossley engines running at 160 revolutions per minute, for export to South America. They have also secured the order for the whole of the motors for this particular job, there being in the aggregate 85 motors averaging about 20 H.P. each.

Silver Medal.—The Horsfall Destructor Co., Ltd., of Leeds, at the Manchester Sanitary Institute Exhibition, were awarded the Institute's silver medal (the only award) for their improvements in refuse destructors. It may be remembered that the silver medal was awarded to the firm by the Sanitary Institute in 1896, and the gold medal awarded at the Brussels Exhibition in 1897. We have received from the Horsfall Company a circular sheet showing their "Loidis" patent forced draught furnace as fitted to 12 Lancashire boilers at a Merthyr colliery.

Photo-Printing.—Messrs. Norton & Gregory, of Westminster Palace Gardens, S.W., have sent us a sample of their photo copies from tracings by their black line process on cloth. The special feature of this process, so far as we are concerned, is its admirable suitability for reproduction by photo-lithography or photo-zincography. Many of our contributors appear to be unaware of the fact that only in rare cases can ordinary blue prints—white lines on blue ground—be reproduced direct; the same is true of most of the purple-line and other similar processes, so that such prints have to be traced or gone over with ink or pencil, a tedious and expensive matter. The black line process, however, yields a print exactly like a drawing in black ink on a pure white ground; the work is done in a few hours, either on paper or on cloth as desired, and we can heartily recommend it. Besides this process, Messrs. Norton & Gregory employ the ordinary processes, do drawing office work of all kinds, and supply paper and other materials.

Hands, Ltd.—Mr. W. Plender announces that, acting under the instructions of Mr. Thomas R. Ronald, general manager and secretary of the Law Guarantee and Trust Society, Limited, the duly appointed agent for the trustees for the debenture holders in the above company, he has taken possession of all the assets of the company, including stock and book debts. Mr. Plender is asking for statements of claims against the estate to be sent in to him.

The directors of Messrs. Hands, are, through their solicitors, also sending out a circular. They say that the above trustees have, "for reasons the directors are unable to appreciate, and without formal notice, taken possession of the properties belonging to the company, and, until their claim is satisfied, or matters are arranged with them, the claims of the trade creditors will have to stand aside. The directors, having regard to the financial position of the company, have every reason to believe that all the creditors will be paid in full, but they deem it advisable to at once put the true state of affairs before you." For this purpose a meeting has been convened for Tuesday next, September 23rd, at 3 o'clock, at Guildhall Tavern, Gresham Street, E.C.

E.C.C. Scholarship.—In order to encourage the young employés at their works in technical studies, and more especially in advanced courses of electrical engineering at the Borough Technical Schools, the directors of the Electric Construction Co., Ltd., of Bushbury, Wolverhampton, have offered free scholarships covering class fees for the 1903-4 session.

Liquidation.—A petition for winding up the Electromotion Corporation, Limited, is to be heard on October 28th.

Chain Grate Stokers.—Messrs. Babcock & Wilcox, Ltd., have just secured from the Underground Electric Railways Company (of London) Limited, at Lots Road, Chelsea, an order for 128 chain grate stokers which are to be used in connection with 64 of their boilers recently sold to this company. This is the largest order for chain grate stokers that has ever been booked at one time.

Engine Contracts.—Messrs. Browett, Lindley & Co., Ltd., have recently booked the following orders:—Two 450 brake engines for Weston-super-Mare, to the order of the Electrical Power Distribution Co.; one 40-KW. combined set to the order of the Patricroft Workhouse; two 300-H.P. engines for the London, Brighton and South Coast Railway, to the order of Messrs. Dick, Kerr & Co.; three 750 brake engines for the Birmingham and Midland Tramways, to the order of the Electrical Power Distribution Co.; one 500 brake engine for the Bradford Colliery, to the order of Messrs. J. H. Holmes & Co.; two 60 brake engines, to the order of Messrs. Crompton & Co., for abroad; two 80 brake and one 45 brake engines to be coupled to Mavor & Coulson dynamos, for Kingseat Asylum.

Charge of Fraud.—The Falkirk police have apprehended an electrician named James Brown, *alias* William Taylor, on two charges of fraud said to have been perpetrated in the month of April, 1901. The accused is stated to have pretended to Mr. Laurie, electrical engineer, Falkirk, that he represented a Greenock firm who has the contract for the work at Dullatur House, Dullatur, which lies midway between Falkirk and Glasgow, and in this way he induced Mr. Laurie to give him 64 electric lamps, eight light brass fittings, 11 holders, and a number of other electrical articles. Information of the frauds was circulated at the time by the Falkirk police, and they received a communication that Brown had been arrested at Newcastle-on-Tyne on similar charges. He there received two sentences of 12 months' imprisonment to run concurrently. On his liberation the other day he was apprehended in connection with a number of Scottish charges, including the Falkirk frauds. On Wednesday last week he was judicially examined before the Sheriff and committed to prison pending further investigation.

Rating of Electrical Works.—Great increases in the assessment of electrical works at Chelmsford have been made by the Union Assessment Committee, and will doubtless lead to appeals. The assessment of the Chelmsford portion of the arc works of Messrs. Crompton & Co., Limited, have been increased from £225 to £700, and the other portion, which is in Whittle Parish, from £600 to £2,190—a total increase of £2,065. The assessment of the Wireless Telegraph Company, Hall Street works, has been increased from £89 to £186; and the electric light works and wires from £310 to £640.

G.E.C. Football Club.—The General Electric Company's Football Club will be pleased to arrange dates with clubs of other electrical houses for fixtures for the coming season. Communications should be addressed to Mr. H. Bowthorpe, hon. sec., 71, Queen Victoria Street, E.C.

Fire.—The whole of the electric light plant at the Sanatorium for Consumptives at Nordrach-upon-Mendip, was destroyed by fire on Friday.

ELECTRIC LIGHT AND POWER NOTES.

Aberdeen.—A serious breakdown occurred last week in the mains of the Corporation electricity system, affecting the lighting of the whole of the city. The tramways were not affected.

Ashford.—The U.D.C. is considering a proposition that application be made to the L.G.B. for sanction to borrow £15,000 for electric lighting purposes.

Auckland (N.Z.).—A report on electric lighting and power for the Auckland Harbour Board by Mr. W. G. T. Goodman has been presented to the Board. Mr. Goodman states that electricity as a power for crane and capstan work is far more suitable than hydraulic or steam power, and estimates the number of lamps required at 40 arc lamps and 737 incandescent lamps of 16 C.P. He strongly recommends the direct current system, and submits two sample systems. Taking all the circumstances into consideration, concludes the report, it would be cheaper for the Board to obtain the power either from the City Council, if the latter erect a generating station, or from the tramway company if it will undertake the supply.

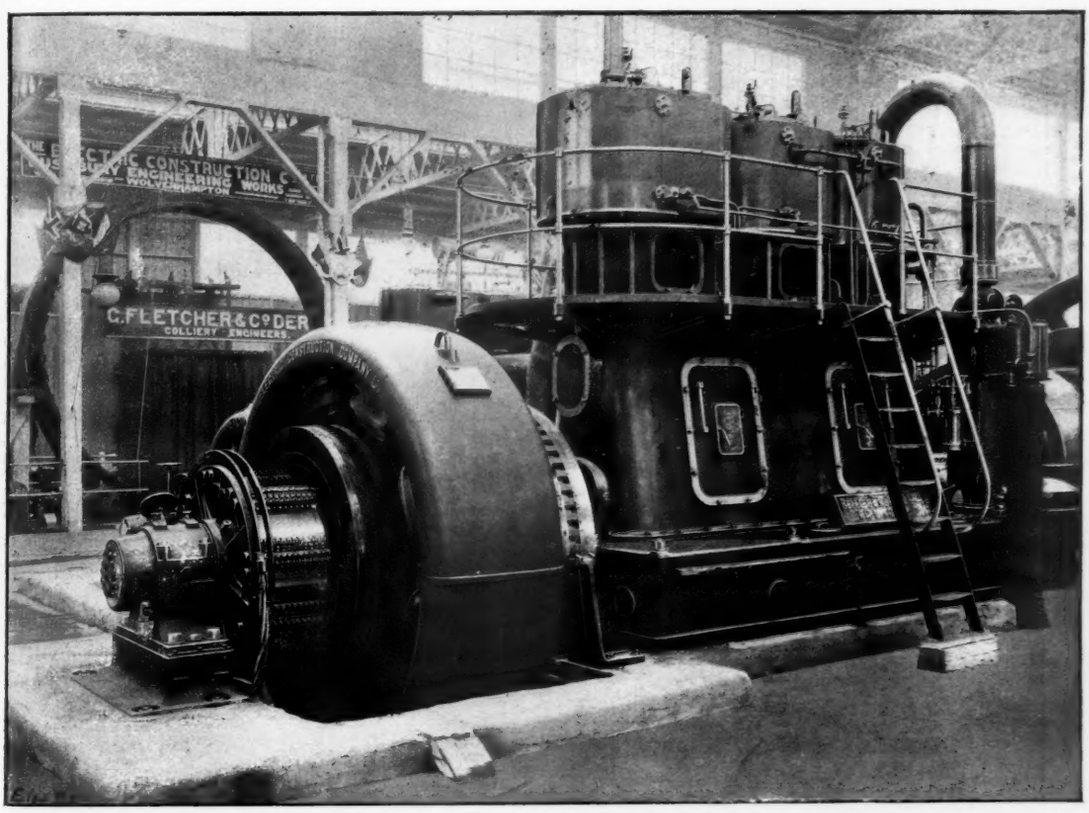
(Continued on page 507.)

THE WOLVERHAMPTON EXHIBITION.

(*Continued from page* 372.)

The Electric Construction Company, Limited, of Wolverhampton, in addition to a large exhibit at their stand, show two generators in the "power" department, both of which are coupled to engines by Messrs. Belliss & Morcom, Limited, of Birmingham. We understand that these were the first of the combined sets to be completed ready for steam.

The larger set is shown in the following view; it is of the Electric Construction Company's standard multipolar type, shunt-wound, with a normal continuous output of 500 kw., at from 450 to 520 volts, and is suitable for use either for lighting or traction. The field magnet coils and pole-pieces are of high permeability steel, the yoke being of selected cast-iron. The armature is of the slotted type, with drum barrel winding, consisting of interchangeable and renewable former-wound coils. The conductors and end connections are continuous, and without joints in any portion, except where connected to the commutator. The core is built up of finely laminated soft charcoal iron, and is provided with ample ventilation by means of specially constructed ventilating ducts distributed over the armature. The commutator is of ample size, of hard drawn copper sections, the insulation used being specially selected mica. The machine is fitted with carbon brushes, and commutation is sparkless at all loads, with fixed brushes.



Belliss & Morcom-E.C.C. Steam Dynamo.

The engine is of Messrs. Belliss & Morcom's 800-B.H.P. standard, and runs at a speed of 330 revolutions per minute, with a steam pressure of 170 lbs. per sq. in. It is of the double-acting, triple-expansion type, having three cylinders, high, intermediate, and low, working on cranks set at 120°. The cylinders are fitted with piston slide valves, and are designed to be self-draining. Oil is supplied to all bearings by means of a simple form of pump without valves or packing, at a pressure of 10 to 25 lbs. per sq. in., through a specially arranged system of oil channels. The oil escaping from the bearings drains into the crank-pit, to be used over again. This system of forced lubrication was originated by Messrs. Belliss & Morcom in 1890, and they have since that time worked it out in all its details, with the most satisfactory results. The engine is typical of their latest triple-expansion design, of which a large number are in hand and at work, including some 20 sets of 1,000 to 1,200 B.H.P., and others of 1,500 and 2,250 B H.P.

The smaller dynamo is of the Electric Construction Company's compound and shunt-wound type, having an outpu of 250 kw., at 500 to 550 volts as a compound machine and 460 to 500 as shunt, and closely resembles the 500-kw. machine mentioned above. It is driven by a double-acting triple-expansion engine, of Messrs. Belliss & Morcom's 400-B.H.P. standard, running at a speed of 400 revolutions per minute, with the same pressure of steam.

Both of these sets are of handsome appearance, and bear evidence of the best construction and workmanship.

Messrs. Joseph Evans & Sons, of Wolverhampton, provide a battery of feed pumps for supplying the feed water to the main range of boilers. These are fixed in an extension of the boiler house; they draw their water from a storage tank supplied from the Corporation mains. The

steam pressure carried in the main boilers is 180 lbs. per sq. in., and the discharge water passes through a relief valve loaded to 200 lbs. per sq. in. pressure when not required in the boilers.

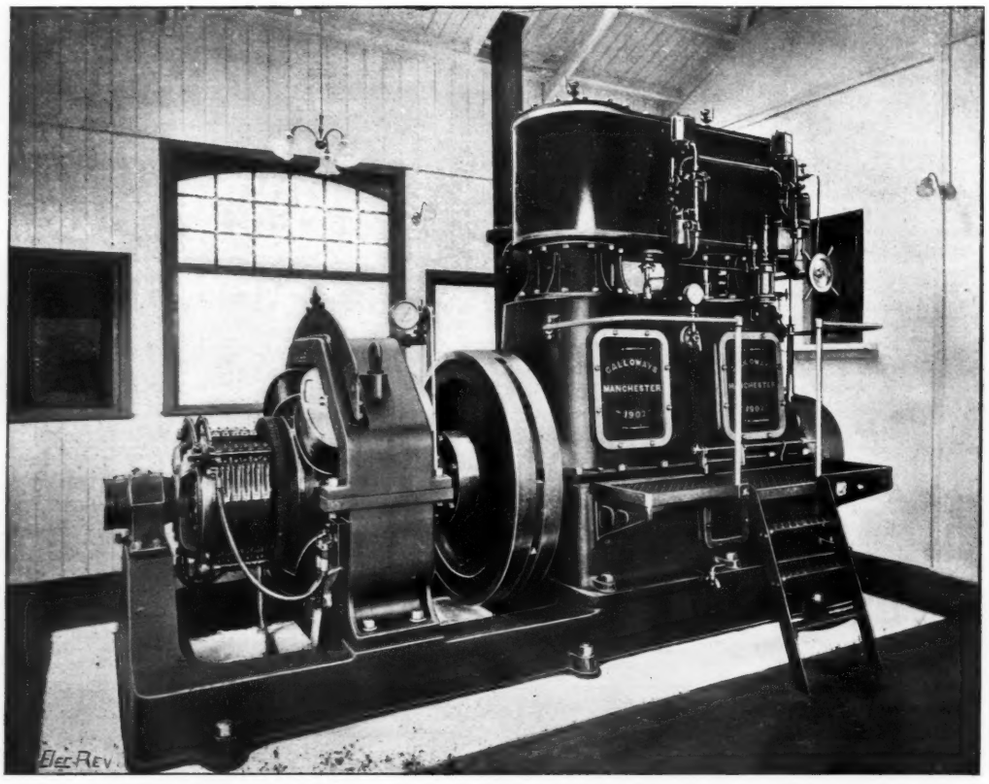
There are three separate pumps, all of which are on the compound principle; two of these pumps are horizontal, and fitted with the firm's patent "Cornish" system of compound steam cylinders, and double-acting outside-packed-ram pump ends. The steam cylinders are 9 in. and 16 in. diameter respectively, the rams being 7½ in. diameter, all 24 in. stroke. Each of these two pumps, at moderate speed, will deliver 8,000 gallons of feed water per hour, and either of them is capable of taking the maximum load duty that the boilers will be called upon to perform. They can be run as slowly as two piston feet per minute.

The valves in the pump end are of the "double-beat" type, of gun-metal, with flat faces, and each pump is provided with a large air vessel and vacuum chamber; the working of these pumps is so smooth that, when standing by, we could feel no vibration or noise of any kind. The steam cylinders are lagged with sheet steel secured with brass bands, giving a very neat and well finished appearance (see fig. on p. 505). Messrs. Evans and Sons have supplied a number of these pumps for boiler feeding at high pressures for electric lighting station work, where they have been found to give excellent results.

In addition to these two pumps Messrs. Evans & Sons provide an entirely new type of pump, namely, a vertical compound "Beam" feed pump, having 6 in. diameter high pressure and 10 in. diameter low pressure steam cylinders, and two 6-in. diameter single-acting rams, all 18 in. stroke. This pump is capable of delivering about 3,500 gallons of water per hour, and is calculated to deal with the ordinary day load on the boilers. It is well known that the fly-wheel pump, with vertical single-acting rams, is one of the most efficient and reliable types of feed pump for moderate pressures of steam, and for regular work. In the "Beam" feed pump, illustrated on p. 505, the crank motion and fly-wheel are dispensed with, but the same general arrangement of steam cylinders and rams is maintained; the two sides, however, are coupled together by means of a steel beam oscillating on a central shaft. Each pump ram has a crosshead and slide arrangement, enabling the radial motion of the beam to accommodate itself, the actual travel of the slipper block, however, being very small; for a 12-in. stroke of ram it is about 1 in. only.

The high pressure steam cylinder is placed over one ram, and the low pressure cylinder over the other; the steam valve motion is driven by means of a small crank on the end of the beam shaft, connected by means of a rod to a small "L" lever, mounted on a suitable bracket.

The latter lever, in its travel, moves a small auxiliary valve working in the high pressure steam chest, and so admits steam to either end (as the case may be) of a piston working in a small supplementary cylinder. This piston is attached by means of a suitable spindle to both the high pressure and low pressure slide valves, so that, when it is driven over by the steam, it reverses the slide valves of both steam cylinders simultaneously. The working speed of this pump can be regulated to a mere crawl.



Galloway-Mather & Platt Steam Dynamo.

Messrs. Evans & Sons also provide the whole of the pipes, valves and connections for the installation of these pumps, the arrangement being such that any pump may work independently of the others, or the whole of them simultaneously, if desired.

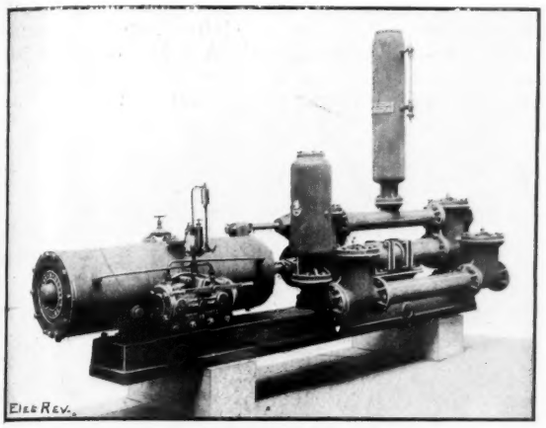
Messrs. Galloways, Limited, of Knott Mill Iron Works, Manchester, have an electrical set in operation, consisting of one of their vertical compound two-crank high-speed engines in conjunction with a dynamo by Messrs. Mather & Platt, Limited. A view of this set is given above.

The normal power of the engine is 300 H.P. when running at 380 revolutions per minute, and it is capable of dealing with overloads up to 30 per cent., according to the conditions of steam pressure and exhaust. The cylinders are 15 and 24 in. in diameter respectively, and the stroke 10 in.

The frame is well ribbed internally, fitted with large doors to give free access to the working parts, and is provided with a water cooling jacket in the top of the chamber to prevent heating of the frame and of the oil used for lubrication. The cast-iron distance pieces between the frame and the cylinders form bored guides for the cross-heads, and are fitted with a wiper gland on the piston rods to confine the

oil in the crank chamber, sufficient length being given to ensure that no portion of the piston rod subject to oil splashing enters the main packing.

The cylinders are clothed with asbestos and felt, and lagged externally with planished steel. The covers are of



Ram Pump. (Messrs. J. Evans & Sons.)

cast-iron, turned on the inner surfaces, and jointed to the cylinder flanges by ground metal-to-metal joints. The pistons are of conical form, machined all over, and have cast-iron rings sprung into grooves in the body; the high-pressure piston is of cast-iron, and the low pressure of forged steel.

The distribution of steam is effected by piston valves fitted into liners in the cylinders, and worked by eccentrics. The high-pressure valve is double-ported to steam, and has ample openings even when cutting off early; it is a plain casting, and the renewal is a simple and inexpensive matter. The low-pressure valve is fitted with solid renewable rings.

The forced lubrication system is automatic throughout, oil under pressure being supplied to every bearing in the engine by means of a simple valveless pump fixed in the base.

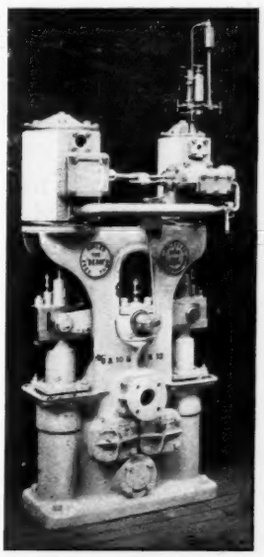
The governor is of the inertia throttling type, acting on balanced equilibrium valves, and is adjustable for speed whilst running.

A good idea of the general massive character of the engine structure may be gathered from the following details:—Piston rods 3 in. diameter. Main bearing next fly-wheel 6½ in. diameter × 15 in. long. Two main bearings each 6 in. diameter × 8 in. long. One end bearing 6 in. diameter × 10 in. long. Crank-pins 6½ in. diameter × 9 in. long. Total weight of engine, 12¾ tons.

Special plant has been put down recently at Messrs. Galloways, Knott Mill works to ensure the highest class of workmanship and finish, every portion being made to gauge or template, so that replacement at any time is a simple matter.

The Mather and Platt generator is designed for an output of 175 KW. at a pressure of 500 volts when running at a speed of 380 revolutions per minute. The field magnets of the machine are of cast-steel, the poles and yoke being cast in one; the yoke is divided horizontally. The poles are shunt wound, and are fitted with an internal ring of cast-steel, designed to prevent sparking and obviate the necessity for moving the brushes with change of load.

The armature is built up of annealed varnished wrought-iron plates, the outside diameter of which is 30 in., and



"Beam" Pump. (Messrs. J. Evans & Sons.)

their length parallel to the shaft, 15 in. In the periphery of the plates are 80 slots, in which are placed the conductors of high conductivity copper, insulated from each other and from the iron core.

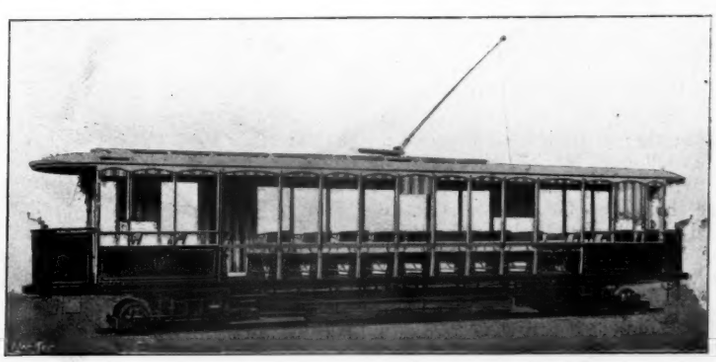
The commutator is composed of 320 bars of solid copper, insulated by mica and clamped together by massive steel end rings.

After running for 10 hours on full load, the rise of temperature of any part of the machine is guaranteed not to exceed 70° F. The efficiency is very high, the losses only amounting to a total of 10 KW., or less than 5½ per cent. of the input to the dynamo. The machine will stand an overload of 25 per cent., and will work sparklessly under the most severe conditions of running.

(To be continued.)

THE ROTHESAY ELECTRIC TRAMWAYS.

The Rothesay Tramways Company successfully inaugurated the electrification of their tramway system on August 13th, when the current was switched on for the first time by Provost McIntosh, in the presence of a large and interested company. Among those present were the Provost of Greenock, and representatives of all the local authorities, including the Burgh of Rothesay and the County Council.



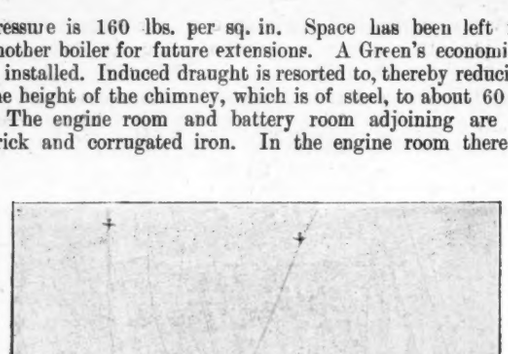
Rothesay Tramways: Summer Car.

The guests, about 100, were conveyed in the old horse cars from Rothesay Pier to the generating station at Point-house. The power house adjoins the road, and is about 1½ miles from the Rothesay end. It occupies the site of the old stables. It is not yet quite complete, but when finished its equipment will be as follows.

The boiler house, of corrugated iron, contains two Babcock & Wilcox latest type of boilers, each of 250 H.P. capacity, fitted with Vicars automatic stokers. The steam

pressure is 160 lbs. per sq. in. Space has been left for another boiler for future extensions. A Green's economiser is installed. Induced draught is resorted to, thereby reducing the height of the chimney, which is of steel, to about 60 ft.

The engine room and battery room adjoining are of brick and corrugated iron. In the engine room there is



ROTHESAY TRAMWAYS: VIEW ON LINE.

one McIntosh & Seymour horizontal tandem compound engine direct coupled to a Westinghouse generator of 200 KW. capacity; also two Browett-Lindley sets direct coupled to two English Electric Company (Dick, Kerr and Co.) generators, each of 150 KW. capacity. The switchboard and booster are also placed in the engine room. The battery is of the Tudor Company's cells, and has a capacity of 300 ampere-hours.

The car shed adjoins the power house, and has three lines of rails running into it. A fitting shop for repairs adjoins, and working pits have been left, so that all cars can be examined from below.

Great difficulty was encountered in building the power station and car sheds, owing to the very hard nature of the rock and the extraordinary amount of surface water encountered. This delayed the opening considerably, and as a result, all the enormous holiday traffic of July was lost.

The old track was a single one, but in changing over the track has been doubled. The gauge is 3 ft. 6 in. The rails weigh 94 lbs. per yard; they were laid in 60-ft. lengths, and "Crown" bonds have been used throughout. The overhead wire is No. 0 S.W.G. The track is comparatively level, and runs along the shore road for almost its entire length. As at present laid down between Rothesay and Port-Bannatyne, the distance is only 2 miles 670 yards, but powers have been obtained for extensions to Ettrick Bay and Kilchaltan Bay, about 10 miles.

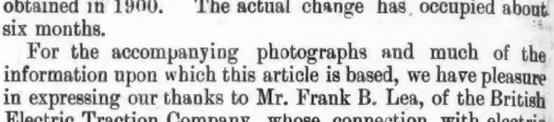
The rolling stock equipment consists of 10 open cars, suitable for summer use, as shown in one of the accompanying illustrations, while for winter use there are five cars of Dick, Kerr's special type, one-half being closed in, the remainder being as in the photograph. All the car equipments are of the English Electric Company's manufacture, while the cars were also built at the Preston works.

The contractors for the whole of the system were Messrs. Dick, Kerr & Co. The consulting engineers were the British Electric Traction Company, Limited, who have a controlling interest in the Rothesay Tramway Company, Limited.

The fare for the distance, 2⅜ miles, is 2d., but there are 1d. stages from either end.

The first horse car ran on this system in 1882. The traffic in 1890-1 was 414,000 passengers, while for 1901-2 it was 712,000 passengers. Negotiations for the electrification commenced in 1899, and provisional orders were obtained in 1900. The actual change has occupied about six months.

For the accompanying photographs and much of the information upon which this article is based, we have pleasure in expressing our thanks to Mr. Frank B. Lea, of the British Electric Traction Company, whose connection with electric traction in this and other countries dates back to the time when the electric tramway industry was only just "beginning to begin." Our thanks are also due to Mr. Thomson, secretary of the Rothesay Tramways Company.

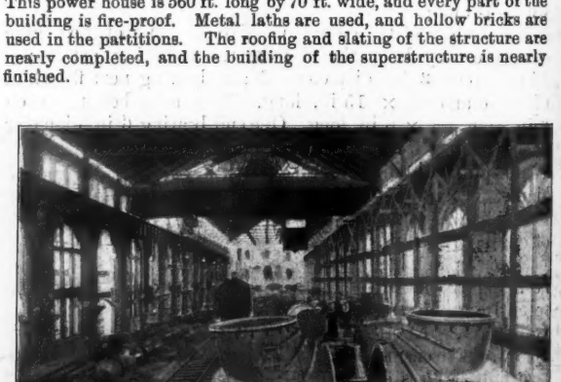


VIEW OF NIAGARA NEW POWER HOUSE.

THE NEW POWER HOUSE AT NIAGARA

BY ORRIN E. DUNLAP.

WITHIN a few weeks the Niagara Falls Power Company will be supplying electric power from power house and wheel-pit No. 2. This power house is 560 ft. long by 70 ft. wide, and every part of the building is fire-proof. Metal laths are used, and hollow bricks are used in the partitions. The roofing and slating of the structure are nearly completed, and the building of the superstructure is nearly finished.



INTERIOR VIEW OF NIAGARA NEW POWER HOUSE.

The National Contracting Company, which had the contract for the wheel-pit work, has completed its contract, and the work of clearing away the construction plant is under way. Mr. Walter McCulloh, resident engineer of the National Contracting Company, is looking after this work, and of the plant, which was valued at $130,000, all but from $10,000 to $15,000 worth has been disposed of to various parties. The completion of this contract leaves the work in the hands of the Niagara Falls Power Company and the contractors on the installation. The covered forebay at the

west side of the building is well advanced, and water has been let into it. This forebay is 40 ft. wide, and extends nearly the entire length of the building. The racks of power house No 1 are uncovered, but the racks of power house No. 2 are protected by this forebay structure. In the inlet canal a dredge, with scows and a tug, is at work removing the big coffer-dam that was built to aid in the work.

The interior of the building presents a wonderful scene of development. All around parts of the turbines, generators, switchboards and other apparatus to be installed await the moment when they shall be needed to fit in the place they are designed to occupy in this remarkable plant, which is to develop 55,000 H.P. of the force of the Niagara. The I. P. Morris Company, of Philadelphia, has many men at work in the wheel-pit erecting the turbines and shafts. In power house No. 1 the wheels are numbered 1 to 10 inclusive, and in power house No. 2 the first wheel will be known as No. 11. Already wheels Nos. 11, 12 and 13 are set, and the shaft of No. 11 is in place. The turbines that are being installed were designed by Escher, Wyss & Co., of Zurich, Switzerland, and built by the I. P. Morris Company. The governors were also designed by Escher, Wyss & Co., and are being built by A. Falkenau, of Philadelphia.

The General Electric Company has commenced the erection of the first generator. The six generators first to be installed will be very similar to those now in operation in power house No. 1. They will be of the external field type and have the nickel steel revolving magnet ring, but the iron bridge over the machine will be omitted, a fact made possible by placing the collector rings at the bottom instead of at the top of the dynamo shaft. The regulation of the machines in station No. 2 will be much closer than on those in station No. 1.

Last winter the immense quantities of ice in the river in front of the inlet canal gave considerable trouble, owing to the shallowness of the channel. A dredge is now at work out in the river in front of the canal deepening the channel in order that there may be a greater flow of water into the inlet. The 10 turbines now in operation in wheel-pit No. 1 serve to create a pretty stiff current in the inlet canal, which will be greatly increased in speed by the operation of the 11 wheels to be placed in the new wheel-pit. This pit is 463 ft. 8 in. long, 18½ ft. wide, and 178½ ft. deep. The wheels will work under a head of 145 ft., and will be of the Francis or inward discharge type.

The work on the new development has been in progress considerably over a year. To a degree, the labourers have now given place to the skilled hands from the several great contracting companies. At the south end of the transformer station an addition is being built. William A. Brackenridge, resident engineer of the Niagara Falls Power Company, is in charge of all the work. The expectation is that power from the first wheel and generator will be available about October 1st.

ELECTRIC LIGHT AND POWER NOTES.

(*Continued from page* 502.)

Abersychan.—The Council has resolved to take immediate steps to obtain a prov. order from the B. of T. for electric lighting.

Ashton-under-Lyne.—On the recommendation of the Electricity Committee, the T.C. has fixed the charge for energy to the Corporation tramways at 1½d. per unit. It is reported that during August, by the utilisation of the destructor and new condenser, the consumption of coal at the electricity works was reduced from 120 to 80 tons.

Ayr.—The annual report of the burgh electrical engineer (Mr. A. J. Fuller) was presented at a meeting of the T.C. last week. It stated that the number of units sold for private lighting was 102,553, giving a revenue of £3,765; for public lighting 330,560 units, giving a revenue of £2,147; and for traction 132,105 units, yielding a revenue of £827. The total revenue was £6,973, and the expenditure was £4,483. The surplus balance of £2,490 was £756 short of meeting the payments to interest and sinking fund. The capital expended on the works to date was £78,999, an increase during the year of £22,841.

Bexhill.—The U.D.C. has resolved that additional buildings at the generating station be designed to hold engines and boilers of 3,300 KW.

Brighton.—The E.L. Committee of the T.C. has asked the Portslade, Southwick and Shoreham Urban Councils if they are willing that the Corporation should supply electricity within their districts, and if so, whether they would support the Corporation in an application for the necessary powers.

Bristol.—Owing to the unsatisfactory nature of a canvass of the district, and the large capital outlay needed, the Electricity Committee of the T.C. has decided not to extend the alternating current mains to Hotwells.

Broughty.—The electric light was turned on to the public lamps on Wednesday last week. The formal inauguration will take place on 24th inst., after which date customers will be enabled to take advantage of the new illuminant.

Caerphilly.—The D.C. has appointed Mr. R. H. Fletcher consulting electrical engineer to the Council in connection with the proposal to apply for a prov. order for supplying the district with electricity.

Cardiff. — The Lighting and Electrical Committee has received a letter from the L.G.B., refusing to sanction the loan of £107,611 for extensions at the Roath power station; there appears to be some friction between the Board and the B. of T., who have given their sanction. Up to the present time £48,750, out of £107,611, has been expended, and the demand for light and power is increasing at such a rate, that the Committee will be in a deplorable state unless the extensions are made. Mr. Ellis stated that if the L.G.B. had their own way, it would be necessary to erect a third station, which would be a waste of money. They objected to the expenditure upon the continuous-current supply, on account of the plant having been put down at the power station. He suggested that the Tramway Committee should obtain the sanction of the B. of T., and sell the energy to the Lighting Committee.

Colne.—The new electricity station in Philip Lane is to be opened on Thursday next, September 25th. Mr. Councillor Hewitt, chairman of the Electricity Committee, will perform the ceremony.

Colwyn Bay.—The D.C. has decided to obtain sanction to borrow £2,500 for the extension of the electric light system.

Coventry.—The E.L. Committee has ordered two additional Bennis stokers to be fitted to the old boilers, the two now in use having proved successful. Two tenders have been accepted for the supply of motors, and a scale of charges fixed for the hire of the same.

Dorchester.—The T.C. on September 9th decided to send two of its members to other towns to collect information on electric lighting. On their return Messrs. J. and J. S. Enright, consulting engineers, will be asked to advise the Council.

Dorking.—The U.D.C. has decided to apply for a loan of £20,000, the amount estimated as necessary for Edmundson's Electricity Corporation, Limited, to carry out the electric lighting scheme.

Dumfries.—At a meeting of the T.C. on Thursday last week it was reported by the Electric Lighting Committee that they had forwarded to Prof. Capper copies of the letters which, since the publication of his report upon the electric lighting of the burgh, have appeared in the local newspapers criticising that report, and requesting the Professor to furnish such a reply as he may be prepared to make upon the criticisms referred to. They also asked for an explanation upon what ground he preferred steam to gas as a motive power. The Committee's action was approved of, and notice was given of a motion for the next meeting that the Electric Light Committee be instructed to ask for offers for the electric lighting prov. order for both lighting and traction, &c.

Eton.—Mr. E. B. Denton has submitted to the U.D.C. a report on the advisability of adopting electrical power at the Sewage Works. The Windsor Electrical Installation Company had offered to provide plant free and carry out a six months' test at a charge of 3d. per unit for energy. Mr. Denton estimates the outlay if the scheme is adopted, at £405 15s., and states that by the adoption of electricity there would be an estimated annual saving of £99 5s.

Edmonton.—The U.D.C. last week resolved to invite three electrical engineers to submit reports and estimates of the cost of schemes for carrying out the electric lighting order of the Council, and an estimate of the annual expenses and revenue; also that the North Metropolitan Electric Power Supply Co. and other firms be invited to submit their terms—(1) for supplying electrical energy in bulk; and (2) for supply and distribution complete for all purposes.

Falkirk.—The T.C. has decided to introduce the electric light into the purifier, exhauster, and governor houses at its gas works, and has agreed to give the North British Railway Company a supply of electric light at the motor rate.

The E.L. Committee has been empowered to borrow £10,000 on short loan for the electric light scheme, in order to allow it time to fix a permanent loan.

Farnham (Surrey).—The U.D.C. has rejected the proposed scheme of electric lighting, for carrying out which Messrs. Edmundson's offered generous terms.

Hampton Wick.—Messrs. Christian & Phipps, Limited, have asked the U.D.C. for consent to carrying electric light wires under the High Street, but the Council has replied that it cannot consent to the application unless a prov. order is obtained.

Hythe (Kent).—The T.C. has entered into an agreement with the Folkestone Electricity Supply Co. for the installation of electric light in the town.

Kilmarnock.—The T.C. has agreed to ask Prof. Kennedy to furnish a report as to the best method of supplying the burgh with electric power for lighting and traction.

Kirkby Stephen.—The installation of electric power for the lighting of the station and sidings of the North-Eastern Railway Company at Kirkby Stephen is now completed, and the new power, which is derived from a waterfall on the River Eden, was introduced for the first time on Friday last. All the station build-

ings, locomotive workshops and sheds, signal cabins and posts are supplied with the electric light. In course of time, it is stated, the electrical plant will, in conjunction with pneumatic power, be utilised for working the railway signals and points in the Kirkby Stephen marshalling yard. The intake is protected by cast-iron strainers carried on steel girders concreted into the rock. A sluice valve is fixed at the head of the pipe line, fitted with an extended hand gear, so that the sluice may be manipulated from a point on the bank. The pipes are of riveted steel, 21 in. diameter, bolted to the rock face, and where necessary supported on masonry arches and piers. The turbine has an output of 20 H.P. on a fall of 22 ft. From the switchboard the current is conveyed through aerial cables to the battery house, situated about a quarter of a mile away in a building close to the station premises. The battery consists of 56 cells, and has a capacity of 110 amperes for six hours. The existing gas signal lanterns have been adapted for the electric light. The signal lamps are all 8 C.P., and are found to give a much superior light to the old gas lights. The platforms and gangways of the station proper are lit up by 32-C.P. lamps in watertight fittings. A luggage hoist worked by an electric motor is being erected capable of raising a load of 1 ton from the platform level to the road level in 15 seconds. The sidings, cattle mounts and locomotive coaling platforms are lit by means of arc lamps. The fitting shop is driven by means of an 8-H.P. electric motor. This motor has been so designed and connected that, should the water-power plant fail through any cause, it can be driven by the steam engine which formerly drove the fitting shop, and, acting as a dynamo, supply the necessary current for the installation until the main supply is again in order. This interesting work has been designed and carried out by Mr. V. L. Raven, of the North-Eastern Railway Company, and Mr. Gilbert Gilkes, of Kendal. Mr. J. W. Stroughair, of the North-Eastern Railway locomotive department, superintended the work.

Leatherhead.—The local electric lighting company has informed the U.D.C. that it is now prepared to supply the Council with energy.

Leek.—An inquiry into the U.D.C.'s application for a loan of £10,061 for electric light purposes was held on Friday; there was no opposition.

London.—An explosion from an electric cable occurred last week in Panton Street, Haymarket, blowing up the pavement in front of the Comedy Theatre. It was followed by flames, which scorched the front of the theatre and adjoining premises. The fire was extinguished with difficulty. A man who was passing when the explosion occurred was badly injured and had to be taken to hospital. The cables which caught fire were those of the Charing Cross and Strand Electricity Corporation, and the explosion involved no fewer than six distributing boxes.

Midsomer-Norton.—The U.D.C. has decided to take no further steps at present with regard to electric lighting.

Newcastle.—The Tramways Committee has decided to reduce the charge for lighting the electric lamps in the city from £18 per lamp per year to £15 10s., as it has been proved that the latter sum is sufficient to cover all costs.

Northfleet.—The Kent Electric Power Syndicate and the Gravesend Corporation are proposing to supply electricity to the U.D.C.

Portsmouth.—The T.C. has adopted a recommendation of the E.L. Committee to erect a workshop at the electric lighting station, at an estimated cost of £1,250, which sum it is proposed shall be provided out of the surplus arising on last year's working, estimated at about £4,000.

Prestwich.—The B. of T. has deferred the consideration of the revocation of the electric lighting order for one year from August 20th, 1902.

Romford.—An offer by the United Electric Light and Power Company to construct electricity supply works at Romford is under consideration by the U.D.C., which has a prov. order for the supply of electricity in the district. The Council contemplates seeking further advice from Mr. W. C. C. Hawtayne.

Scunthorpe.—The U.D.C. has decided to apply to the B. of T. for a prov. electric lighting order.

Sheffield.—The E.L. Committee has passed a resolution requesting the Parliamentary Committee to include the following provisions in the next Bill to be promoted by the Corporation, viz., To authorise the Corporation to purchase electric motors for the purpose of letting the same out on hire. To authorise the Corporation to expend moneys for putting in installations of electric light and power, and to empower the Corporation to accept payment for the same by instalments or to let the same out on hire. To obtain power to postpone the payment of contributions to the sinking fund in respect of all capital expenditure on the new power station at Old Park Wood for five years after the completion of the works.

We wonder what the local contractors think of this move. Already the Corporation manufactures all kinds of accessories in its own workshops, including transformers, &c.; now it is preparing to actively compete with its own ratepayers in installation work, using those ratepayers' cash and credit for the purpose. When will the British public awake and realise what it is doing?

Stonehouse.—The Devonport T.C. has decided to oppose an application of the Provincial Electric Supply and Traction Company to the B. of T. for a prov. order authorising the supply of lectricity in Stonehouse.

Stonehaven.—The T.C. is considering a scheme for lighting the town with electricity.

Sunderland.—Mr. J. F. C. Snell, borough electrical engineer, has just issued a lengthy report on the question of supplying electrical energy for the driving of motors in the local shipyards. The matter arose from the application of the North-Eastern Marine Engineering Company, Limited, to be supplied with energy on terms which were much below the usual prices. The company, our Sunderland correspondent was given to understand, pointed out that on the Tyne, where it had another engine works, it could get energy at a very much cheaper rate than on the Wear, and the committee was apprehensive that unless it took some steps to meet the demand that was in this way foreshadowed, it might find ultimately that it had lost a valuable source of revenue. It at once considered the subject, and the report referred to above is the practical outcome.

The report commences by stating that now is the time for the committee to offer manufacturers electrical energy on such terms as will render it unprofitable for them to instal their own plant, and Mr. Snell considers it to be of the utmost importance that the Corporation should make it possible to supply this power. He then points out the value of the shipyard supply, as it would enable the load factor to be very considerably raised, which would materially reduce the proportionate cost per unit. Mr. Snell has ascertained that the cost to a shipyard providing its own energy varies from 1d. to 1½d. per unit according to the nature and size of the output. In order to supply these customers they must be prepared to supply at about the above-mentioned prices; this can be done safely and without unfairness to other classes of consumers, and unless this class of power consumer can be obtained, the minimum charges to all classes can never be reached. For instance, the tramways department, which now pays 2d. per unit, would be able to look forward to a price only a little higher than that proposed to be charged to the shipyards provided they could obtain this power load. He proposes a scale of charges ranging from 2¾d. per unit for the first 500 units per quarter to 1½d. for all energy beyond 100,000 units per quarter.

Owing to the extended radius of supply, and the ultimate probability of a still greater area, he advises that the system of transmission in future shall be by three-phase high-pressure currents generated at 5,500 volts, at a frequency of 50 cycles per second. The current so generated at Hylton Road station would be transmitted by high-pressure cables to certain sub-stations, at which there would be located motors driving low-pressure D.C. generators at the same pressure as the present general supply.

After dealing with the necessary alterations to the present generating stations, Mr. Snell submits the following estimate for carrying out the complete scheme:—

Two 300-KW. three-phase generators Nos. 4 and 5; two 700-KW. three-phase steam generators, No. 6 and 7; three Lancashire boilers, No. 6, 7 and 8, economiser No. 2, induced draught fans, pumps, high-pressure switchboard, cable connections, &c.; foundations, boiler seatings, &c.	£27,920
Monkwearmouth Sub-Station.—Two 275-KW. motor-generators; battery, switchboards, land and building ...	7,975
South Docks Sub-Station.—Two 250-KW., and one 500-KW. motor-generators, switchboards and building	6,820
Hendon Sub-Station.—Two 250-KW. motor-generators; switchboards, land and buildings	5,170
Pallion Sub-Station.—Two 250-KW. motor-generators with switchboards and buildings	4,455
High-Pressure Transmission Mains.—Stoneware casings and road work, £11,272; three-core cables, £6,748; telephone cables, £288	18,308
Total	£70,648

As the first requirements would be at South Docks and at Monkwearmouth, it would only be necessary at once to instal the following plant:—

Hylton Road Station.—One 700-KW. steam three-phase generator, two 300-KW. three-phase generators, one Lancashire boiler, one induced draught fan, high-pressure switchboard and cable connections	£11,000
South Docks Sub-Station.—Two 250-KW. motor-generators, switchboards, buildings and cables	9,800
Monkwearmouth Sub-Station.—Two motor-generators, switchboards, buildings and cables	9,535
Total	£30,335

Mr. Snell appends an estimate for 1903-4. The plant installed is put down at 4,000 KW., and the total capital expenditure £240,000, or £60 per KW.; the estimated output is 3,610,000 units. The total expenditure is put down at £19,045, and the revenue at £35,575, leaving a gross profit of £16,530. Interest and sinking fund would account for £15,000, so that there would be a net balance of £1,530.

A meeting of the Council was held on Wednesday last to decide the matter. Mr. Snell's report was adopted, and the Council resolved to apply for powers to carry out the scheme and to borrow £74,000. It was stated that practically every shipyard and engineering works in the borough was considering the adoption of electric power: one shipyard had already undertaken to consume 600,000 units, and another one 220,000 units per annum.

Sunninghill.—The Ascot and District Electric Supply Corporation has notified the P.C. of its intention to apply for a prov. order to supply the district.

Swindon.—The T.C. has adopted a scheme for the wiring of consumers' premises, and has decided to invite tenders from wiring contractors.

Taunton.—The T.C. has entered into an agreement with the National Free Wiring Company whereby the Corporation will pay 11 per cent. per annum on the cost of unpurchased installations, which at present stand at £2,119 1s. 10d., in lieu of the present charge of 1d. per unit, with a minimum of 1s. per annum for each 8-c.p. lamp installed. This will make an annual payment of £233 2s. to the company, or 1·37d. per unit. The amounts payable to the company in 1900 and 1901 were £245 18s. 2d. and £255 15s. 4d. respectively, and the company's claim in respect of these years will be settled on the same basis.

Trowbridge.—The Somerset and District Electric Power Syndicate has informed the U.D.C. of its intention to apply for powers to supply within the Council's area. The Electricity Committee is considering the matter.

Wakefield.—The City Council has resolved to apply to the L.G.B. for a loan of £15,000 for electric lighting purposes.

Walton.—Certain residents having requested Messrs. Edmundson's, Limited, to supply them with electricity for lighting, the company has obtained the permission of the U.D.C. to extend its mains to their houses, subject to an agreement being entered into to hand over the cables to the Council if required. Supply will be given from the Weybridge electricity works.

Whitehaven.—The T.C. has instructed the electrical engineer, Mr. P. J. Watt, to prepare a report upon the charges for energy with a view to a reduction being made. At the meeting of the T.C. on September 10th, Mr. Watt was complimented on the completion, without mishap, of the changing-over to the higher voltage. The large works at William Pit are to be supplied with energy at 2d. per unit as an experiment. Some of the electric light mains, which were laid in open tiles or bricks, instead of solid bitumen, have been found to be saturated with coal gas, necessitating relaying. The Corporation is considering the question of the liability of the gas company in the matter.

Wigan.—A L.G.B. inquiry was held last week re the Council's application for sanction to borrow £10,000 for electricity supply purposes. Two previous sanctions to borrow money had been obtained, which made a total of £101,500, out of which the Corporation has expended £88,668. There was no opposition to the application.

Wilmslow.—As the Council's prov. order is to be revoked if action is not taken before January 1st next, the U.D.C. has decided to establish electricity works itself. The Alderley and Wilmslow Electric Supply, Limited, had given notice of its intention to apply for a prov. order.

Wimbledon.—A L.G.B. inquiry has been held into the Council's application for leave to borrow £8,000 for electric light purposes.

Wishaw.—Having received proposals from two companies to bear the whole expenses of a prov. order, and to supply public and private lighting in the burgh, the Council resolved that the offer of the Clyde Valley Electrical Power Company be accepted, on condition that the Gas Committee could arrange an agreement with it.

ELECTRIC TRACTION NOTES.

Antwerp.—The long-promised electric tramcars at Antwerp, the result of the decision of the Municipal Council taken about two years ago, have at last made their appearance on the boulevards.

Antwerp—Brussels.—The concession—in principle—of the Antwerp—Brussels electric railway has been granted to Messrs. Empain Frères. The details of the project remain only to be definitely arranged, and these are at present under discussion between the concessionnaires and the Belgian Railway Department. The trail of the line has already been decided upon. The central power station will be situated at Malines, which is exactly mid-way between Brussels and Antwerp. There will be no level-crossings. To commence with, 12 motor cars will be utilised, and the entire project is estimated to cost about 50 million francs (£2,000,000). Messrs. Empain, we understand, are simply asking a 2½ per cent. guarantee from the State, and on this basis are prepared to construct and equip the line completely.

Ashton-under-Lyne.—T.C. has decided to retain Mr. Appelbee, the borough electrical engineer, as consulting electrical tramways engineer.

Birkdale.—The electric trams have been such a great success in Birkdale and are in such great request that petitions have been sent to the Council and the B.E.T. Co. for further extensions.

Bradford.—At a mass meeting of Bradford tramway employés held last Sunday morning, at which 500 men were present, it was unanimously decided that unless the Tramways Committee of the Corporation give a satisfactory reply to certain demands before the 24th inst., a ballot shall be taken on the question of a strike. The men demand a week of 60 hours to be worked in six days, split turns to be abolished, spare men to receive 2s. for turning up for duty if not required, stooling to be abolished, promotion to be by seniority and merit, eight hours' rest between full day's work, 30 minutes to be allowed before taking a car out in the morning and 15 minutes after arrival at the depôt at night, present system of checking to be abolished, and, as far as possible, all men to be attached to the depôt nearest their homes. The men claim that they have taken every possible means towards an amicable settlement, and that they have not been treated with proper courtesy in return.

Brighton.—A scheme for the construction of three lines of electric tramways from the junction of Buckingham Place and Dyke Road to the borough boundary at a cost £20,771, from the same junction to the proposed Hove line in Goldsmid Road, at a cost of £2,532, and from the junction in Victoria Gardens to the junction in Goldsmid Road, at a cost of £13,853, has been prepared by the Tramways Committee of the T.C. It is recommended that a Bill should be prepared to confer powers to construct and work the lines and carry into effect any agreement which may be come to with Hove in connection with the scheme.

Bromley (Kent).—The B.E.T. Co. has asked the U.D.C. to allow it to submit a plan for connecting the town with Penge by means of electric trams.

Cardiff.—It is calculated officially that for the remainder of the municipal year the profits on the tramways will not only pay all charges, but leave a balance of nearly £3,000 for depreciation. The Electric Lighting Committee's accounts show a net profit of £1,121 15s. 2d.

Dukinfield.—The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board has decided to extend the tramways at Dukinfield so as to join the Ashton-under-Lyne service, and not to at present proceed with the tramway and lighting scheme for Mottram-in-Longdendale.

Dudley.—The T.C. last week adopted the resolution of a committee of the whole Council agreeing as to the expediency of purchasing the whole of the tramways within the borough under conditions set forth in agreements with the Dudley and Stourbridge Tramway Company and the British Electric Traction Company.

Exeter.—The City Council is asking the B. of T.'s consent to the serving of notice upon the present horse tramway company, of intention to purchase the undertaking prior to the initiation of the Council's proposed electrical system.

Folkestone.—The T.C. has decided to put in force the powers conferred upon the Coporation by the Folkestone Corporation Tramways Order, 1901.

Halifax.—The Corporation Tramways Committee has recommended the T.C. to extend the electric tramways from Stump Cross to Hipperholme at a cost of £8,365 12s. 6d., and from Salterhebble to West Vale, at a cost of £3,253.

Handsworth.—The U.D.C. has consented to the use of cable traction by the City of Birmingham Tramways Company for another six months, pending the completion of the electric tramways.

Hove.—At a special meeting of the T.C. on Monday, it was decided by 16 votes to 14 not to proceed with the proposed electric tramway route in Waterloo Street.

Keighley.—Negotiations are well advanced between Mr. R. C. Quinn and the authorities of Shipley, Keighley and Bingley for the construction of a tramway by Mr. Quinn to run from Shipley to Keighley in continuation of the Bradford to Shipley line.

Liverpool.—The chairman of the Tramways Committee, Mr. S. W. Higginbottom, M.P., the deputy chairman, Mr. Alderman F. Smith, and Councillor E. L. Lloyd, have been appointed a sub-committee to consider the question of the carriage of merchandise over the tramway system; to confer with the Mersey Docks and Harbour Board; and to take the necessary steps to enable them to report fully on the subject.

Thirty new cars for the electric tramways are being fitted with the new cover designed by Mr. C. R. Bellamy and his staff for the protection of outside passengers.

London to Dover.—Messrs. Norman & Stigant, solicitors, have written to the Rochester T.C. informing them that the promoters of the mono-railway had decided to select the route from London to Dover, through Rochester and Chatham, in preference to other routes if they could be assured of the cordial and active support of Rochester and Chatham authorities and the U.D.C. of Gillingham in their Bill in the ensuing session of Parliament. It was resolved that in the event of the line being brought through Rochester and Chatham, with a station in the district, the Corporation generally approved of the project. It was also resolved that a committee should meet the Chatham Corporation to confer as to the matter. Since then the two bodies have met and considered the proposal, and the Chatham Corporation is also in favour of the scheme.

Middleton.—The T.C. have decided to reduce the price for electricity for power and for lighting from 2½d. to 2d. per unit. It was reported that the trams being laid on the Manchester New Road from Blackley by the Manchester Corporation would shortly be completed. Delay has been occasioned by the telegraph wires being in the way of the tramway poles, but this, it was stated, was

shortly to be overcome, the Manchester Corporation having consented to pay for the raising of the poles on the route. The rails have been laid to the Middleton railway station, and as soon as the poles are erected the cars can commence running, the power being obtained from the Middleton electricity works.

Oldham.—Record traffic was done by the trams during the annual holidays. Three new routes have been opened after inspection by Major Druitt, R.E., of the B. of T.

Portsmouth.—The T.C. has authorised the Tramways Committee to proceed with the erection of workshops at North End at a cost of £7,946, and also with the erection of offices, mess room and recreation room, at an estimated cost of £1,350. In the original estimate, allowing for a deduction which was made by the Board of Trade, a sum of £5,000 was included for the erection of the workshops, and the Committee, therefore, recommended that application be made to the Board of Trade for sanction to borrow £4,296, being the difference between the estimated amounts above stated, and the sum of £5,000, included in the original estimate. This recommendation was also adopted.

Ramsbottom.—The U.D.C. has decided to engage Mr. Chattwood, electrical engineer, to formulate a scheme for a system of tramways from Holcombe Brook to Edenfield, through the centre of the town, at a fee of £250.

Rawdon.—The D.C. is in negotiation with persons who wish to obtain a provisional order to run a tramway through the district, linking it up to a Leeds line.

Richmond.—Colonel Von Donop on 12th inst. held a Board of Trade inspection of the extension of the L.U. Tramways system from Twickenham to Richmond.

South Shields.—The B.E.T. Co. has informed the Harton Parish Council that powers are to be applied for to lay down tramways from Whitburn, through Cleadon, Harton and South Shields to a terminus adjacent to the starting point of the proposed South and North Shields Tube. The Council has decided to give consent and support.

Spain.—An electrically-operated cable ropeway is being established between the Celra iron-ore mines of the station at Celra, on the Madrid, Zaragoza and Alicante Railway.

Steyning West.—For some time the R.D.C. has been in negotiation with the B.E.T. Co. with reference to the provision of electric trams for the district. When the draft agreement was received on September 11th, it was pointed out that it was in the name of the Shoreham Tramway Company, and objection was taken on the ground that there would be no guarantee that the B.E.T. Co. would be responsible if the line were not opened within the stipulated period of three years. It was decided to go into the matter fully a fortnight hence.

Sweden.—If the Swedish Chambers adopt the Bill that is about to be presented to them for the appropriation of the various waterfalls of consequence in the kingdom for the production of electric energy, Sweden will be the first country to transform steam traction on its railways generally into electric haulage. The necessity of importing large quantities of coal on the one hand, and the plethora of water-power on the other, and the consequent national economy that would result from utilising it, leave little doubt that the Bill will be favourably received by Parliament. Only falls of 1,500 H.P. would be utilised, and with the exception of the powerful Harsproenget Falls (situated at 50 kilometres from the railway) all the others are in close proximity to the different main lines, and could be most economically employed. The different sections of the north-east lines would at first be transformed. The Stvolien and Bracke line would afterwards be taken in hand, and then the Norrland Railway. The industrial section from Gellivara to Ofoten would next be transformed, and, finally, the State lines in the south-west.

Sydney (N.S.W.).—In connection with the proposed conversion of the steam trams to electric traction, the Railway Commissioners some time ago made inquiries with a view to the possible introduction of the double trolley wire system on the Sydney and suburban lines. The inquiry was prompted by the fact that the present system of bonding the rails to provide a sufficiently conductive return was proving a somewhat costly operation, not only with regard to initial outlay, but also in the matter of upkeep. The most competent officers in the Government Electrical Department went thoroughly into the question, and also made an inspection of the working of the double trolley system on the Lady Robinson's Beach line. The result of the inquiries made is a report in favour of continuing the present single trolley wire system, and although a few new lines have already been laid down in anticipation of the introduction of the double trolley system, they will now be bonded in the usual way. Generally speaking, it was considered by the authorities that the trunked nature of the lines in and around Sydney necessitated the use of such a vast number of joints or "frogs" for the overhead wires, that the doubling of these connections would inevitably lead to confusion, dangerous working, and a possibility of cars being continually thrown out of circuit, especially if any great speed were maintained. As it is, even with the single trolley wire system, there is already a sufficiently cumbersome network of overhead wires at the "railway gates," and the number of "frog" connections will be considerably added to by the introduction of the altered suburban system at the new central railway station, where a complicated system of points has necessarily to be laid down.—*Sydney Daily Telegraph.*

Valtellina Railway.—Messrs. Ganz & Co., of Buda-Pesth, write informing us that the traffic on the Sondrio-Colico-Chiavenna line of the electric main railway which they have built in Upper Italy, was opened on the 4th inst., and that since that time the regular express messenger and freight traffic on that line has been carried on without the least hitch. There are about 30 trains run per day. The electric working of the Lecco-Colico section of this railway will be opened in a few days.

Withington.—The B. of T. has approved of the system of electric traction proposed to be adopted for the tramways.

The U.D.C. on September 11th received from Mr. T. S. Turnbull an intimation that he had been instructed to apply to Parliament for powers to construct and equip an electric tramway connecting the present terminus at Stretford with Altrincham, Sale and Withington, provided the approval and support of the authorities interested was secured. The Tramways Committee was requested to interview Mr. Turnbull on the matter.

Wolverhampton.—The Lorain Co. have admitted their liability for the loss of a horse killed on the tram lines soon after their opening. At the meeting of the Town Council last week the Finance Committee recommended, under the head of "Tramway revenue account (electric traction)," the payment of £40 compensation to Mr. J. Gibbons, and £10 10s. solicitor's costs, respecting Mr. Gibbons's claim for the horse killed on the tram line in Pipers Row. Alderman Lewis, on the recommendation being presented, said he hoped the Council would note that the Lorain Company would pay the money, and that they thereby admitted their liability. The recommendation was adopted. The new single line to the Dog and Gun from Newbridge was inspected on Wednesday last week by Colonel Von Donop on behalf of the Board of the Trade, in presence of members of the Town Council and representatives of the Tettenhall Urban District Council, through whose district the line passes. An experimental car accomplished several journeys along the section during the early part of the morning. This, as well as the car containing the inspector, climbed the Tettenhall Rock incline and rounded the points with smoothness, and the descent was made with equal success. As a result of the inspection, the line was opened for traffic on Saturday; and it has since been very well patronised. A 10 minutes' service is being run.

TELEGRAPH AND TELEPHONE NOTES

Brighton Telephones.—The Telephones Committee has received from Mr Bennett a revised estimate for the construction of the proposed municipal telephone system, excluding from the scheme the cost of all works in Hove. The Committee recommends an application for a loan of £42,000 instead of £45,000 previously asked for.

London—Brussels Telephone.—The Brussels correspondent of the *Daily Chronicle* reports that the new London—Brussels telephone will most likely be inaugurated in the month of November. The laying of the cable between St. Margaret's Bay and La Panne having been completed, it remains only to instal the aerial wires between these points and London and Brussels respectively.

New Zealand Telegraphs.—At the end of March last there were 21,705 miles of telegraph wires in use in New Zealand, as compared with 20,682 miles at the end of the preceding 12 months, an increase of 1,023 miles. The number of messages dealt with increased from 3,898,128 to 4,167,981.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899 ..	..
Communication with Carthagena and Barranquilla (Columbia)	Dec. 8, 1900 ..	..
Trinidad-Demerara No. 1	Aug. 27, 1901 ..	..
Communication with Bolama	April 18, 1902 ..	..
St. Lucia-St. Vincent	May 8, 1902 ..	..
St. Lucia-Grenada	May 8, 1902 ..	..
Dominica-Martinique	May 8, 1902 ..	..
St. Lucia-Martinique	May 8, 1902 ..	..
Guadeloupe-Martinique	May 9, 1902 ..	..
Santa Cruz de Teneriffe to Tejita de Teneriffe	July 4, 1902 ..	..
Puerto Plata-Martinique	July 10, 1902 ..	..
Guantanamo-Mole St. Nicholas	Aug. 5, 1902 ..	..
Cayenne-Pinheiro	Aug. 13, 1902 ..	..
Landlines :—		
Route *vis* Hanekin on Persian territory	Feb. 24, 1900 ..	..
Communication with Tientsin and Taku *vis* Hoeampo	July 18, 1900 ..	..
Communication with Juneau, Alaska	Aug. 19, 1902 ..	Sept. 8
Corean Lines	Sept. 9, 1902 ..	Sept. 10

Portsmouth Telephones.—Mr. Bennett, the engineer under whose supervision the telephone system is being carried out by the Corporation, has advised that, with regard to the accounts for toll system, the rendering of quarterly accounts is preferable to monthly. The accounts are, therefore, to be collected quarterly. On the recommendation of the Committee, the T.C. has approved of the contract with Bullers, Limited, for the supply of insulators.

CONTRACTS OPEN AND CLOSED.

OPEN.

Ashford (Middlesex). — September 25th. No. 1, dynamos, booster, storage battery, switchboard, &c.; No. 2, feeders and wiring. See "Official Notices" September 12th.

Aston Manor. — September 19th. Coal bunkers and conveyor for the electricity works. See "Official Notices" August 29th.

Belfast.—October 10th. Electric motors (12 months' supply) for the Corporation. See "Official Notices" to-day.

Bexley.—September 30th. (*a*) Transformers and pillars, condenser, air pump, water softener, &c. (*b*) Feed pumps and piper. (*c*) Travelling crane. See "Official Notices" September 12th.

Blackburn. — September 29th. Electrically-driven travelling crane. See "Official Notices" September 12th.

Burton-upon-Trent.—September 30th. Supply and laying of electric mains, conduits, junction boxes, &c. See "Official Notices" September 12th.

Dresden. — October 1st. A competition for a safety apparatus in connection with the working of electric tramways will be decided on the date mentioned by the Communal Administration of the town of Dresden (Saxony). Three prizes of 5,000, 3,000 and 2,000 marks will be awarded.

Dundee.—September 24th. Section A, water-tube boilers, with mechanical stokers and superheaters; Section B, induced draught apparatus, also carbons for public lamps. See two "Official Notices" September 5th.

Dungannon.—September 24th. Gas producer plant, gas engines, dynamos, &c., for the Council's electricity scheme. See "Official Notices" September 5th.

Grimsby.—September 20th. Continuous-current motors for letting out on hire. See "Official Notices" September 12th.

Huddersfield.—September 30th. High and low tension cable. See "Official Notices" to-day.

Ilford.—October 6th. Dry-back boiler, piping and condensing plant for electricity works extensions. See "Official Notices" to-day.

Ipswich. — September 24th. Repair of battery, and supply of meters for Workhouse. See "Official Notices" to-day.

Isle of Thanet.—Stores for the Electric Tramways and Lighting Company. See "Official Notices" to-day.

Italy.—September 27th. The Italian Department of Public Works will on this date consider offers for the concession of an electric tramway between Bayonne and Vigo.

Maidenhead.—October 6th. Installation for the Guildhall. See "Official Notices" to-day.

Middlesex.—October 7th. The Light Railways Committee of the Middlesex County Council invites tenders for the construction of permanent way (for electric traction), bridge work, &c., of about 11 miles of light railways. The conditions, specification, &c., may be seen at the offices of H. T. Wakelam, M.I.C.E., county engineer, Middlesex Guildhall, Westminster.

Montreal.—The Montreal Light, Heat and Power Company, of Montreal, announce that they require about half a million feet of multiple duct conduit, and are open to receive propositions from British manufacturers therefor.

N.E. Railway.—October 7th. The directors are inviting tenders for the complete electrification of about 37 miles of standard gauge line (double track mostly). For further particulars see our "Official Notices" July 25th.

Roumania.—The Roumanian State Railway authorities have just invited tenders for the installation of an electric lighting and power transmission plant in the railway workshops at Jassy.

Shanghai.—October 30th. (*a*) Two 500-kw. steam alternators; (*b*) switchboards; (*c*) two condensers and pumps. See "Official Notices" September 12th.

Spain.—September 23rd. Tenders are being invited until the 23rd inst., by the municipal authorities of Celanova (province of Orense) for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Celanova (Orense).

Spain.—September 29th. The Public Works Department, Madrid, wants offers for concession of an electric tramway between Vigo and Bayonne.

St. Petersburg.—November 1st (14th). The T.C. invites tenders for the reconstruction of the three town tramway lines, hitherto worked by horse traction, with electrical power, and the construction of an electric station. The terms of the tender, also application forms with particulars, will be sent free at once either by post or wire. The last date for the production of projects and offers is as above, and applications should be addressed: Stadt Amt, St. Petersburg, Russia.

Stalybridge.—October 13th. The Stalybridge, Hyde and Dukinfield Electricity Board invites tenders for Lancashire boilers, economisers, condenser and pumps, piping, crane, &c. See "Official Notices" to-day.

Swindon.—September 19th. Lighting switchboard and all accessories. See "Official Notices" September 5th.

Swindon.—October 4th. Section A.—Station lighting, and motor wiring; Section B.—Testing instruments and accessories. See "Official Notices" to-day.

Swindon.—October 7th. Installations for consumers' premises for the T.C. See "Official Notices" to-day.

Tien-Tsin. — November 30th. The Municipal Secretary at Tien-Tsin is calling for proposals for the lighting of the British concessions by electricity. See this column for August 15th.

West Ham. — October 7th. Forty-six lighting and traction poles. See "Official Notices" to-day.

CLOSED.

Coventry.—The T.C. has accepted the tender of the British Schuckert Company for a 600-kw. alternator.

France.—The French Ministry of the Colonies has placed a contract with the Société Metallurgique de Gorcy (Meurche et Moselle) for 150 tons of galvanised iron telegraph wire 5 mm. dia., for the telegraphs in Cochin China at 255 fr. per ton.

Holland.—Two tenders were submitted to the municipal authorities of Amsterdam for the supply and installation of the cables required in connection with the Corporation electric lighting station. The lowest was that of the Western Electric Company, London (759,925½ fl.); the Callender Cable & Construction Co., London, asked 813,853½ fl.

India.—The Bengal Iron and Steel Company have placed a further order with Messrs. Crompton & Co., Ltd., of Chelmsford, for two dynamos for direct coupling to Willans engines of 300 H.P.

London.—The Secretary of State for War has accepted Geipel & Lange's tender for 67 Geipel steam traps of the No. 2 size for the Royal Gunpowder Factory, Waltham Abbey.

Newport (Mon.). — The chairman of the Electricity Committee last week asked the Corporation to give the Committee power to withhold the contract for the supply of the power engine by Messrs. Markham & Co. if necessary as they had a dispute with the company. This was agreed to.

South Africa.—The Municipality of Johannesburg have placed an order with Willans & Robinson, Ltd., of Rugby, for one of their 240-H.P. compound engines.

Southend-on-Sea.—The Corporation of Southend have decided to instal a Willans engine of 250 H.P. direct coupled to a Bruce Peebles dynamo for supplying power to their electric tramways.

Swindon.—The Guardians having received permission from the L.G.B. to instal electricity in the Workhouse, has accepted the tenders of the Northern Electrical Company and the Tudor House Company for the laying down of the plant and wiring.

Watford.—The School Board has received the following tenders for installing the electric light in the new Victoria Boys' School:—

	Conductors in steel tubes.	Conductors in best white wood.
Rogers & Gowlett, Watford (accepted)	£118 10 0	£96 5 6
Harold Downer, Watford	125 12 6	119 10 0
Watford Engineering Works	139 0 0	133 1 0
Firth & Son, Watford	138 0 6	134 0 0
Ridout, Watford	166 0 0	166 0 0

Wolverhampton.—At the last meeting of the Guardians the Clerk reported that he had been in correspondence with Messrs. Woods & Co., of Blackburn, on the subject of the electric installation at the new workhouse for which they had obtained the contract, including the supply of Belliss engines. It appeared that it would be much more convenient if these engines were supplied through the Electric Construction Company, who were also to supply the dynamos, and Messrs. Woods had consented to this arrangement. The chairman, in reply to Mr. Pritchard, explained that the arrangement would make no difference either in the character of the engines or the cost, but would cause a considerable saving of time and be a great convenience.

Yorkshire.—The Wheldale Iron and Coal Company have decided to instal a 200-H.P. Willans engine for direct coupling to a dynamo of Messrs. Holmes's make, the combined plant being used for electrical power work in connection with their colliery.

NOTES.

Natal's Electrical Possibilities.—The largest dairy farm in the Colony of Natal is situated at Nel's Rust, and is owned by that enterprising gentleman, Mr. Joseph Baynes, C.M.G., J.P., who represents the constituency of Ixopo in the Natal House of Assembly. The dairy in question is probably the most perfect of its kind in the whole of Southern Africa. Its features include two electrical plants—one driven by a 15-H.P. turbine and connected with various works on the farm; the other, a 60-H.P. turbine, which has to do more particularly with the large refrigerating apparatus. Mr. Baynes went to manufacturing firms outside Great Britain for his refrigerating and electrical plant. The latter he got from the United States, and his 60-H.P. turbine was purchased in Switzerland. The plant sent out to him in the first instance from an English house was not equal to his requirements, with the result that it had to be discarded, and—to quote his own words—"my engineer came to Europe with instructions to get the very best machinery that money could buy in any part of the world." Mr. Baynes is a firm believer in the value of electricity as motive power, and deplores the fact that the people of Natal do not turn to better account the numberless rivers and streams which are such a feature of the topography of the Garden Colony. Questioned on the subject in London the other day by one of our correspondents, Mr. Baynes observed, "The people of Natal do not realise what an enormously valuable asset they have in the water-power of the Colony. Several schemes have been projected for the utilisation of the Howick Falls, but objections have been put forward, chiefly on æsthetic grounds, and so far nothing has come of the matter. But there is no need to utilise the Howick Falls, when, as is the case in Natal, you have streams and rivers on every hand. I think we shall be standing in our own light if we don't adopt electricity more widely in Natal than is the case at the moment. The various light railways, for example, could be more advantageously worked by electricity than by steam, I fancy, even if we have, in the first instance, to generate electricity by steam. There are numberless perpetually-running streams which by careful handling could be turned to profitable account. In winter and spring some of these streams get very low, but by a system of water storage this fact need not present any very serious obstacle. We have enormous water-power in the Drakensberg Mountains alone—the water from which descends from an altitude of 11,000 ft. to the sea in something less than 200 miles, and which might and should be used either for the generation of electric power or for the purposes of irrigation. I suppose no other part of South Africa is such an electrical storehouse as Natal. When this is generally realised, I believe it will be found to be quite possible to obtain cheap and efficient electrical energy to drive our little railways and light the streets and houses of our various towns."

Testing Structural Material.—There is no economy greater than a certainty of material. Given material of a known strength on which reliance can be placed that it shall never fall below that strength, and all reason for surplus nominal strength disappears. This is the burden of an article by Mr. Paul Krempointner in *Cassier's Magazine*. He is right within limits. Equally important is a certain knowledge of stresses. Structural steel is a material that has become very certain in its strength, and it can be used with proportionate economy and satisfaction. Not so steel castings, on the uncertainty of which steel founders, we may almost say, pride themselves. At least they like to shelter behind the uncertainty produced by their own inability to produce certain and reliable material. It is to long and repeated tests, mechanical, physical, and chemical, that rolled steel owes its present excellence. Such tests have been made on material since 1781 by a Frenchman named Soufiat. Then there were Bramah, Eytelwein, Tredgold and others, followed by Young, Pictet, and later by Fairbairn. There still remains a good deal of personal knowledge and judgment that cannot be put into the shape of rule and formula. It is probable that such judgment would be greatly advanced were students sent out as inspectors of material for a few months, so as to make them familiar with what tests can be made. At the same time too much must not be made of mere material. An engineer of experience often judges better of certain stress effects and the behaviour of material than he can calculate. Is it not common to calculate a dimension with the largest reasonable factor of safety, only to feel that the result is wrong, and to fall back on experience which after all is an embodiment of factors that do not appear in any ordinary view of the duties of a piece?

Testing Cast-Iron.—How should cast-iron be tested? Dr. Moldenke, who writes in the *Engineering Magazine*, advocates the test to destruction of a percentage of all castings that are sufficiently small to be so employed, but would test larger castings by running round bars from the same ladle as the casting in larger sizes. He asks for bars of 1½, 2 and 2½ in. diameter, according as castings are to be of soft, medium or chilling quality, thus eliminating the effect of green or dry sand casting; and for transverse tests on supports 12 in. apart. Mr. Buchanan, on the other hand, recently advocated the casting of test coupons attached to the casting itself. The Doctor finds fault with this method, though we do not see that a coupon cannot be so cast as to be relieved of any cooling stresses or other interference from the main casting. If it is to be assumed that test bars may fairly represent simultaneously-run castings, probably nothing better than the plain circular bar could be employed. They are simple to mould and cast, and Mr. Thos. West has given full instructions for moulding such bars in a pamphlet issued by the American Foundrymen's Association. Dr. Moldenke, however, writes *molding*, which is an objectionable mis-spelling, only equalled by his further Americanism, "helping us clear away." Why will otherwise well-informed Americans use such spelling and syntax?

Northampton Institute.—The evening courses and classes of this Institute in all technological subjects will commence on Monday next, and the day courses in engineering on Monday, 29th inst. The announcements issued by the principal, Dr. R. Mullineux Walmsley, for the Session 1902—3, give full particulars of the curricula in mechanical and electrical engineering, including electro-chemistry; special facilities are provided for "Internal Students" desirous of qualifying for the B.Sc. degree in engineering of the University of London, to which the Institute is affiliated, and the laboratories are well equipped with a variety of modern appliances.

Municipal Trading.—We learn from the *Times* that Mr. Arthur Chamberlain has addressed a letter on the subject of the proposed municipalisation of the Birmingham tramways to the hon. secretary of the Birmingham and District Trades and Property Association, in which he says he is opposed to the acquisition and working by the City Council of the tramways. He does not consider that the constitution or mode of election of City Councils was intended to lend itself, or, as a matter of fact, does lend itself, to the effective management of commercial undertakings. City Councils, considered as profit-earning bodies, suffered from two radical defects. In one direction their powers were too limited for the effective control of great businesses, and in another direction their personal responsibility was too vague to bring home to them the results of financial mistakes. The Council had it in their power to propose to any company of undertakers their own (reasonable) terms, and it was only if such negotiations failed that they would be justified in taking the risks themselves. The Council was by its constitution much better fitted to conduct such negotiations to a successful issue than to supervise the daily and hourly details of a great business, and there was no reason to suppose that negotiations honestly and skilfully conducted would not result in getting all that tramway municipalisation if successful could give them, and avoiding all the burdens that if unsuccessful it would impose on them.

The Late Sir Frederick Abel.—At the funeral of Sir F. Abel, whose death was announced in our last issue, the Institution of Electrical Engineers was represented by Mr. A. Siemens and Prof. S. P. Thompson, past-presidents, Mr. W. H. Patchell, member of Council, and Mr. W. G. McMillan, secretary. A wreath of flowers was also sent from the Institution, of which Sir Frederick was a past-president and trustee.

The South-Western Polytechnic.—We have received prospectuses of the arrangements at this Chelsea Institute for the forthcoming session. Full particulars are given of the electrical engineering courses of instruction, and also of the mathematics and physics courses. The professor of the electrical department is Mr. C. F. Smith, Wh.Sc., and he is assisted by Messrs. U. A. Oschwald, B.A., and W. H. F. Murdoch, B.Sc., as demonstrators. The new term begins on September 29th, and those who contemplate joining either the day or evening classes, will find views of the different departments, and the most detailed information in the prospectuses of which they can obtain copies from the secretary at the Polytechnic, Manresa Road, Chelsea.

Obituary.—The death occurred on September 13th, at his residence at Manchester, of Mr. William Clapham, of Richard Johnson, Clapham & Morris, Ltd., miners' electric lamp and dynamo brush manufacturers, brass founders, &c., of Manchester and Liverpool. Mr. Clapham had reached the advanced age of 85 years.

An Electrical Post Scheme.—A number of our daily contemporaries have been busily occupied with a proposed overhead electric letter post transmission scheme. We read in one paper that it is the invention of a Count Taeggi, who has already formed a syndicate, and is coming to this country to work it. It is stated that Signor Galimberti, the Italian Minister of Posts and Telegraphs, has appointed a Commission to report on the system. Another paper says that the idea is that of Signor Pisicicella. The proposition is to send aluminium boxes containing letters along overhead wires at the rate of 250 miles per hour. The proposal does not seem to be very original. The Post Office officials have had numerous schemes brought before them from time to time, and the experiments carried out in London years ago for the transmission of messages electrically through underground tubes must not be quite forgotten in the glorification of this new proposal.

An Interesting Return.—The Census returns for Kent show that there are in the county 1,457 persons engaged in electricity supply and electrical apparatus making. At the 1891 census the figures were 203, thus in 10 years the number of persons engaged in the electrical trade has increased by 617·7 per cent., the largest increase in any occupation in the county.

The Goubet Submarine Boat Sold.—The Paris correspondent of the *Morning Post* say that the Goubet submarine boat called after its inventor, who devoted his fortune to perfecting this type, was sold by auction the other day to an engineer for 45,000 fr., after brisk bidding between him and a dealer in old curiosities. Our readers will find a description of the Goubet boat in the Electrical Review for January 10th, 1896.

Personal.—On Thursday, 11th inst., at St. Luke's Church, Southport, Mr. W. Mackintosh, chief assistant electrical engineer in the Keighley Corporation electricity works, was married to Miss M. G. Davies, of Southport.

Mr. W. R. Kelsey, B.Sc., M.I.E.E., has been appointed principal of the Taunton Municipal Technical Institute.

Mr. Wilson has been appointed engineer of the light railways scheme from Brierley Hill through Quarry Bank to Rowley.

Lightning Fatalities.—A man (named Reed) was killed by lightning at Hunton (West Kent) on Wednesday last week. Deceased was at work in the hop fields when a very severe hail and rain storm came on; it is stated that there was an almost continuous roar of thunder and flashes of vivid forked lightning. The medical evidence showed that the lightning had passed through his head and burnt his right shoulder as if a hot iron had been placed on it. There were more external marks of violence on another man who was struck, but his head was not affected, and he was expected to recover. A *post mortem* examination on Reed's body showed that the membranes of the brain were congested, and the heart was affected.

From Hampton Wick, also, a lightning fatality is recorded, while at Esher an organ grinder also succumbed to shock. From various other directions tales of disastrous results have been reported. We note that the principal chimney stack at a Kingston school was struck and shattered, "and although there was a conductor on the stack, it was left hanging like a ribbon."

Electric Shaft-Sinking Gear.—In our article on page 427 of last week's issue, through an oversight which we regret, we omitted to mention that the machinery there described was made by Messrs. A. Hirst & Son, Limited, electrical and mechanical engineers, of Crescent Works, Dewsbury. This firm is doing a good deal of colliery electrical equipment work up country.

Midland Power Scheme.—The whole of the work for this electrical power scheme which was fully described by us last week, was designed by, and carried out under the supervision of, the consulting engineers, Messrs. Kincaid, Waller & Manville, of Westminster.

THE CENTRAL STATION ENGINEER.

The General Purposes Committee of the Darlington T.C. has decided to advance the salary of Mr. Lunn, borough electrical engineer, by £50 a year, without the conditions previously imposed.

The Electricity Committee of Bristol T.C. has appointed Mr. W. B. Morgan, assistant mains engineer, to the post of mains engineer, in succession to Mr. Jenkins, who has resigned.

There were 97 applications for the post of chief assistant at Colchester electricity works. These were reduced to four, and Mr. W. Frisby, assistant engineer at the Stockport electricity works, was appointed.

Following the resignation of Mr. Ernest Marples, electrical engineer to the Hoylake and West Kirby D.C., the Council has decided to advertise for a resident engineer for the generating station at West Kirby, and to offer a salary of £250 per annum.

Mr. Davies, resident engineer to the County of Sussex Electrical Power Distribution Company, at Lewes, has left the Lewes works and joined the company's head office in London, his successor being Mr. Bolton, of Watford.

Mr. A. P. Dryburgh, of Swansea, has been selected for the advertised post of chief assistant at the Dewsbury electricity works. There were 84 applicants.

CITY NOTES.

Drake & Gorham, Limited.

The first annual meeting of this company was held on 11th inst. at Westminster, Mr. B. M. Drake presiding.

The Chairman said that the net profit for the period covered by the accounts amounted to £12,081, after paying all charges and writing off the preliminary expenses. Although the accounts dated from January 1st, 1901, to June 30th last, the vendors were entitled, under the agreement, to interest on the purchase price and to other sums in lieu of profits made prior to the date of incorporation, so that the amount now available was practically the result of 18 months' trading. It was proposed (says the *Times* report) to declare a dividend at the rate of 7 per cent. per annum, and, in the directors' report, it was recommended that the balance should be dealt with by placing £2,000 to reserve and carrying forward £1,246. This suggested transfer of £2,000 to reserve had no reference to the compulsory reserve alluded to in the prospectus, as that only came into operation when a dividend of 10 per cent. had been paid. Since the report was issued, the board's attention had been called to the fact that the company's articles did not apparently make provision for the formation of an ordinary reserve, and it had therefore been decided to add the sum in question to the carry forward pending the receipt of legal advice as to the advisability of altering the articles. Having remarked that the outlook was promising, he moved the adoption of the report, which was seconded by Mr. J. C. Forster.

In reply to a Shareholder, the Chairman said that his visit to the United States was undertaken partly on the company's business and partly for his own purposes, and that the expenses had been borne by himself. As a result of his visit they now had an agency established for some electrical devices, which the board hoped to introduce into mills, and others in connection with lighting. He also looked into the question of electrical vehicles and electrical machinery, which, it was thought, were made cheaper and better there, and could be sold to advantage in this country.

The report was adopted.

British Columbia Electric Railway Company.

At an extraordinary general meeting of this company, held at Cannon Street Hotel last week, resolutions altering the articles for the purpose of raising additional capital, which is urgently required, were carried. The chairman said that the shareholders had sent in 313,223 proxies out of 400,000 possible votes supporting the action of the directors. But for this approval, reconstruction at a cost of £10,000 would have been the only alternative course. It was stated that this meeting will have to be followed by six others, occupying two months, or more, before the company would be in an effective position to get the money needed.

Direct West India Cable Company.

The following is a copy of the report which came before the annual meeting, held on Tuesday in London:—

The net result of the year's (to June 30th, 1902) working is a profit of £4,789 10s. 2d., as compared with £5,236 10s. 3d. for the previous year. An interim dividend of 3 per cent. has already been paid, and it is now proposed to make a further equal payment, free of income-tax, which will leave £2,989 10s. 2d. to be carried forward. This will increase the amount to the credit of revenue account to £30,961 15s. 6d. The shareholders are asked to approve the establishment of a staff provident fund in accordance with the details of the scheme to be submitted to the meeting. The company's cables continue to work with complete efficiency.

Offers for the sale of debentures to the trustees were invited in December and June last, and £7,999 5s. was paid for £8,000 of debentures, which amount has been written off capital expenditure.

Halifax and Bermudas Cable Company.

The following is a copy of the directors' report which was submitted at the annual meeting held on Tuesday:—

The net result of the year's working (to June 30th, 1902) is a profit of £3,363 0s. 1d., as compared with £4,904 14s. 7d. for the previous year. An interim dividend of 2½ per cent. has already been paid, and it is now proposed to make a further equal payment, free of income-tax, which will leave £362 0s. 1d. to be carried forward. This will increase the amount to the credit of revenue account to £16,100 14s. 5d. The shareholders are asked to approve the establishment of a staff provident fund in accordance with the details of the scheme to be submitted to the meeting. The company's cable continues to work with complete efficiency. Offers for the sale of debentures to the trustees were invited in December and June last, and £7,999 15s. 1d., was paid for £8,000 of debentures, which amount has been written off capital expenditure.

The Cable Combine.

On Wednesday last week an extraordinary general meeting of the British Insulated Wire Company, Limited, was held at Liverpool for the purpose of changing the name of the company to that of the British Insulated and Helsby Cables, Limited. Mr. E. K. Muspratt presided.

The Chairman stated that it had been agreed, on the amalgamation with the Telegraph Manufacturing Company, Limited, of Helsby, that the names of the companies should be changed. The name proposed was that of the British Insulated and Helsby Cables, Limited. Changes proposed in the articles of association were consequent upon the Companies Act of 1900. If passed, a further meeting would be necessary to confirm. He proposed that the name of the company be changed to that of the British Insulated and Helsby Cables, Limited.

Mr. J. Taylor seconded, and the resolution was carried unanimously.

The Chairman next moved that the necessary alterations be made in the articles of association. This was seconded, and also carried unanimously.

Replying to a Shareholder, the Chairman stated that the business had grown enormously during the last few years, and the amalgamation rendered it necessary to have someone to superintend the whole. The business could not be carried on without a general manager. The directors had been fortunate in securing the services, as manager, of Mr. Sinclair, who was acquainted with the work, having been in the employ of the National Telephone Company.

Electric Railway and Tramway Carriage Works, Limited.

The directors' report to be submitted to the meeting to be held at Preston, on Thursday, September 25th, says that during the year ending June 30th, 1902, the works have been fully maintained as regards buildings and machinery, the cost of which has been charged against revenue. After allowing £4,041 2s. 4d. for depreciation, the profit for the year is £14,854 1s. 1d. to which must be added £2,578 2s. 7d. brought from last year (£3,778 2s. 7d. less £1,200, special allowances to directors), making a total of £17,432 3s. 8d. The directors recommend that this amount be dealt with as follows:—To carry to general reserve fund, £2,000; to pay a dividend of 8 per cent., less income-tax, for the year ending June 30th, 1902, £12,000; to carry forward to next year, £3,432 3s. 8d. = £17,432 3s. 8d. In accordance with the articles of association, two directors retire, viz., Mr. Flett and Mr. Boddington, and being eligible offer themselves for re-election.

Stock Exchange Notices.—The Committee has appointed special settling days as under:—Wednesday, October 1st, Calcutta Tramways Co., Ltd., further issue of 32,268 shares of £5 each, £2 10s. paid, Nos. 70,001 to 102,268; County of London and Brush Provincial Electric Lighting Co., Ltd., further issue of 10,000 6 per cent. cumulative preference shares of £10 each, Nos. 60,001 to 70,000. The Committee also ordered the undermentioned to be quoted in the Official List.—British Insulated Wire Co., Ltd., further issue of 30,000 ordinary shares of £5 each, fully paid, Nos. 70,001 to 100,000; and 20,000 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 80,001 to 100,000; Calcutta Tramways Co., Ltd., further issue of 32,268 shares of £5 each, £2 10s. paid, Nos. 70,001 to 102,268; County of London and Brush Provincial Electric Lighting Co., Ltd., preference shares (as above).

British Insulated Wire Co.—The directors have declared an interim dividend on the ordinary shares to June 30th last at the rate of 8 per cent. per annum.

TRAFFIC RECEIPTS.

Company.	Week ending	Receipts for the week.		Total to date.		Miles open.	
		Am'nt.	Inc. or dec.*	Am'nt.	Inc. or dec.*	This year	Last year.
		£	£	£	£		
Blackburn Corp. Trys. ..	Sept. 12	903	+ 95	21,079	+ 3,742	12½	12½
Blackpool and Fleetwood	,, 13	1,495	+261	15,276	— 672	7½	7½
Bristol Trys. & Car. Co.	,, 12	5,120	+1,169	—	—	28	28
British Elec. Trac. Co.:—							
Devonport	,, 5	514	+ 59	15,427	+ 558	5	5
Dudley—Stourbridge..	,, 5	806	+ 58	26,645	+ 3,453	18½	18½
Gateshead	,, 5	873	+248	26,019	+ 4,345	10½	9½
Gravesend	,, 5	208	—	1,118	—	3½	—
Greenock—Pt. Glasgow	,, 5	636	+417	17,865	+10,578	7½	7½
Hartlepool	,, 5	330	+ 51	9,210	+ 1,169	6½	4½
Kidderminster	,, 5	144	— 12	4,480	— 7	4½	4½
Merthyr	,, 5	218	— 22	7,248	— 1,347	3	3
Middleton	,, 5	364	—	7,488	—	8½	—
Oldham—Ashton ..	,, 5	651	— 10	18,810	+ 760	8	8
Poole	,, 5	351	— 17	9,216	— 160	8½	8½
Potteries	,, 5	1,591	+109	51,844	+ 1,929	28½	28½
Southport	,, 5	395	+178	9,245	+ 3,276	5½	5½
South Staffordshire..	,, 5	705	—118	27,349	— 95	21½	22½
Swansea	,, 5	583	— 25	16,906	+ 1,123	5½	5½
Taunton	,, 5	79	— 43	2 [illegible]4	— 135	1½	—
Tynemouth	,, 5	446	+ 91	10,629	+ 1,180	8½	8½
Wolverhampton Dist.	,, 5	810	+185	6,688	+ 4,888	10½	8½
Rothesay..	,, 5	246	+ 76	+06	+ 244	—	—
Weston-super-Mare..	,, 3	309	—	4,829	—	2½	—
Central London Railway	,, 13	6,1[illegible]7	+479	69,018	+ 5,795	6	6
City and S. London Ry.	,, 14	3,029	+1,193	30,3[illegible]5	+10,124	6½	4½
Doncaster Corp. Trys. ..	—	—	—	716	—	5½	—
Dover Corporation Trys.	,, 13	286	+ 10	8,280	+ 135	3	3
Dublin United Trys. ..	,, 12	4,982	+219	56,162	— 50	46	46
East Ham Tramways ..	,, 6	535	+168	—	—	5	4½
Glasgow Corp. Trys. ..	,, 13	12,700	—1,006	179,519	— 7,910	56	46½
Liverpool Overhead Ry.	,, 14	1,[illegible]92	— 85	17,818	— 1,148	6½	6½
Newcastle Corp. Trys. ..	,, 13	2,905	—	—	—	25	—
Sunderland Corp. Trys.	,, 7	1,321	+128	—	—	17½	17½

* Compared with the corresponding period of 1901.

STOCKS AND SHARES.

Wednesday Evening.

Erratic are the influences at present working upon nearly all the markets of the Stock Exchange, and with business at a low ebb, it does not take much to move prices in either direction. It will be something of a relief to have the meeting of Parliament over, for then information should become available in regard to the new Transvaal Loan, the advent of which is said to be keeping down the price of Consols, and therefore quotations in other investment departments. But the monetary situation in New York has assumed a position the reverse of reassuring, and calm critics on this side are quietly discussing the likelihood of a rise in the Bank Rate to 4 per cent. The markets with which we deal, however, can contemplate with equanimity the outlook for dearer money, and it is doubtful whether a rise in the Bank Rate to 4 per cent. would cause so much as a 5s. fall in Electricity Supply shares, although it might affect Telegraph stocks unfavourably. Some there are who do not hesitate to declare that the financial position in New York is grave enough to arouse fears of a semi-panic, but of course there are always extremists to flatter themselves upon their ability for taking "liberal views."

Central London Deferred stock has risen a point in sympathy with the "better-on-balance" tone which now pervades the home railway market as a whole. The other electrical issues are much as they were a week ago, but Districts present an appearance of remarkable firmness, and the price has jumped to 38. So little floating stock is in the hands of the public, that any small amount of buying suffices to put the price quite disproportionately higher. The company has now commenced experimenting with various electrical devices upon a part of its line at Ealing, besides the Kensington bit. From official utterances made since we last wrote, it would appear that the District is as far off amalgamation with the Metropolitan as ever. The Consolidated stock of the latter company has moved up to 83½, assisted to some extent by the District rise. Great Western and London & South-Western stocks were put down at first when the extension of the London United Tramways Company to Richmond was announced the other day.

Considerable activity prevails in the issues of the London United Tramways at present. The Debenture stocks are 109 and 83 for the fully and partly paid respectively. In connection with the former, some of the members of the Royal Family are sharing our contention that the price is quite high enough—at least, if transfers may be accepted as evidence of the suggestion's truth. At 11⅜ the Preference are rather better, and the price marked 11¼ last Tuesday. The £7 10s. paid Preference shares are 9 middle. Determined attempts are being made to market the Ordinary shares of the London United Tramways. These shares were all paid to the vendors, but latterly a sort of nominal quotation has been established in the Stock Exchange, although, of course, the public can have no shares to sell. For the £10 fully paid Ordinary 22 is bid.

British Electric Tractions are a fairly good market, but despite a number of bargains being transacted in them every day, the quotation of the Preference only has moved up a shade. Several of the Colonial and Foreign tramway shares are active, Anglo-Argentines, for instance at 4½, Calcutta at 7½, and Capes at 2½. While the tendency for electrical traction shares is good, London General Omnibus stock has drooped to about 93.

The City and Surrey scandal drags its weary way across the pages of the newspapers, but the number of shareholders, it is to be hoped, cannot be large enough to make the company's wretched affairs of more than academic interest to most people. A dividend of 8 per cent. with £3,432 forward, is announced by the Electric Railway and Tramway Carriage Works for the past twelvemonth.

Seven changes are displayed by the Electricity Supply section, all of them being in the upward direction. Charing Cross Preference shares are 5s. to the good; St. James's and Pall Mall show a rise of half a sovereign, and Metropolitan First Debenture has again improved a point upon its last week's advance, while the shares are also ½ up. Charing Cross new Ordinary are 8½, while Westminster Preference keep at 6¼. Brush shares continue their downward career, the Ordinary being now quoted 5s either side of a pound. Both City and County Debentures are rather better.

British Insulated Wire shares are 7½, *cum* the dividend at the rate of 8 per cent. per annum declared the other day. Electric Constructions follow the falling tendency of Brush shares, and are down ½, but other miscellaneous descriptions call for no comment.

In the telegraph section a few sellers of Anglo American Preferred put the price down to 93, and brokers with an order in a couple of thousand stock find it very difficult to deal straight away, so limited is this peculiar market. The Eastern group pursues its way to higher prices, Eastern Ordinary adding 1 per cent, and Eastern Extension shares 5s. to their quotations. It is said that the sharp break which has occurred in Yankee rails is responsible for the dulness of the American telegraph section, but unfortunately for this theory, Direct United States shares are 5s. better on the week. Western Telegraph have improved to the same extent, replacing a fall of identical amount last week, and the Debenture stock has advanced to its full par value. No quotable change has resulted from the dividends declared at the meetings on Tuesday of the Direct West India and the Halifax and Bermudas Cable Companies. Both undertakings worked for a slightly less profit for the year ended June 30th last than they did in the preceding twelvemonth, but the dividends remain as before, *i.e.*, at 6 per cent. for the West India, and 5 per cent. for Halifax and Bermudas shareholders.

Globe Preference are ¼ easier, and Oriental Telephones have shed ⅛. National Telephone issues remain steadily firm.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation Sept. 9th.	Closing Quotations Sept. 17th.	Business done during week ended Sept. 17th, 1902. Highest.	Lowest.
£2,300	African Direct Telegraph, 4 % Debs.	100	...	...	...	98 —102	98 —102	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3½— 4½	3½— 4½	...	...
119,700	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	70 — 80	70 — 80	...	...
804,720	Anglo-American Telegraph	Stock	7s/6	3½%	61s.	47 — 50	47 — 50	49	...
3,097,640	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	93 — 95	92 — 94	94	92½
3,097,640	Do. do. Deferred	Stock	£1 7s.	5s.	2s.	7½— 8	7½— 8	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	5 %	3½— 4	3½— 4	...	...
13,333,300	Commercial Cable	$100	8 %	8 %	8 %	160 —170	160 —170	...	...
1,741,029	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	95 — 97	95 — 97	96½	96
16,000	Cuba Telegraph	10	7 %	4½%	4 %	5½— 6½	5½— 6½	...	...
6,000	Do. 10 % Pref.	10	...	...	...	13 — 14	13 — 14	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2½— 3½	2½— 3½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	7 — 8	7 — 8	...	...
60,710	Direct United States Cable	20	3½%	3½%	3½%	10½— 10¾	10½— 11	10⅛	10½
96,300	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 -103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	123 —128	124 —129	128	125½
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	90 — 93	90 — 93	92½	91
1,432,268	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	108 —111	108 —111	109¾	109½
300,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12 — 12½	12¼— 12⅝	12⅝	12 7/16
£20,000	Do. 4 % Deb. Stock	Stock	...	...	...	107 —110	107 —110	...	...
£80,000	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5½%	...	...	99 —102	99 —102	...	...
£200,000	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—6,000	25	...	...	...	101 —104 %	101 —104%	...	...
180,227	Globe Telegraph and Trust	10	5½%	5½%	5½%	9½— 10	9¼— 9⅝	9⅝	9 1/16
180,042	Do. do. 6 % Pref.	10	...	...	...	13½— 14	13½— 13¾	13⅝	13½
150,000	Great Northern Telegraph, of Copenhagen	10	12½ %	15 %	15 %	25 — 27	25 — 27	...	...
70,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	38 — 42	38 — 42	...	...
100,000	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	101 —105	101 —105	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680	1	2½%	...	...	¼— ⅜	¼— ⅜	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	...	...	¾— 1	¾— 1	...	...
983,333	National Telephone, Pref. Stock	100	5 %	5 %	5 %	93 — 95	93 — 95	94½	93
1,966,667	Do Def. Stock	100	...	60	64 xd	55 — 57	55 — 57	...	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 12	11 — 12	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4¾— 5⅛	4¾— 5⅛	5	...
2,000,000	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 99	96 — 99	96⅛	...
500,000	Do. 4 % Deb. Stock Red.	100	...	4 %	4 %	102 —106	102 —106	104⅛	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	6 %	1⅛— 1 1/16	⅞— 1	...	...
100,000	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's	8	5 %	5 %	5 %	6½— 7	6½— 7	...	...
2,303	Submarine Cables Trust	Cert.	...	...	...	110 —120	110 —120	...	...
58,000	United River Plate Telephone	5	7 %	7 %	7 %	4¾— 5¼	4¾— 5¼	...	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4¼— 5	4¼— 5	...	...
179,947	Do. do. 5 % Debs.	Stock	...	...	...	101 —104	101 —104	...	...
15,639	West African Telegraph, Shares	10	...	...	...	3¼— 4¼	3¼— 4¼	4	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ¼	⅛— ¼	...	...
150,000	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	97 —100	97 —100	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	7 %	11½— 12	11⅝— 12¼	12	...
75,000	Do. do. 5 % Debs. 2nd series, 1905	100	...	...	...	102 —105	02 - 105	...	...
343,777	Do. do. 4 % Deb. Stock Red.	100	...	...	...	97 —100	98 -101	100	99⅞
86,321	West India and Panama Telegraph	10	⅝%	¼ %	...	⅛— ¼	⅛— ¼	...	...
34,562	Do. do. do. 6 % Cum. 1st Pref.	10	...	...	...	4¾— 5¼	4¾— 5¼	...	...
4,664	Do. do. do. 6 % Cum. 2nd Pref.	10	...	...	...	3 — 4	3 — 4	...	...
80,000	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	99 —102	99 —102	100	...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord.	1	...	...	...	⅛— ¼	⅛— ¼	...	...
100,000	Do. 4½ % 1st Deb. Stock, Prov. Certs.	100	...	...	...	103 —106	103 —106	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	8 %	10½— 10⅝	10½— 10⅝	10⅝	10 9/16
20,000	Do. do. 7 % Cum. Pref.	5	...	...	...	10½— 10⅝	10½— 10⅝	10 11/16	...
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	9 — 9½	9 — 9½	9 5/16	...
50,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5½— 5⅝	5½— 6	5⅝	...
250,000	Do. do. do. do. 4% Deb. Stock Red.	100	...	...	...	105 —107	105 —107	...	...
£4,000	*Chelsea Electricity Supply, Ord.	5	6 %	5½%	4 %	5½— 5⅝	5½— 5⅝	...	...
150,000	Do. do. do. % Deb. Stock Red.	Stock	...	...	...	109 —112	109 —112	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579	10	4 %	0 %	5 %	9 — 10	9 — 10	9 5/16	9 1/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12½— 13½	12½— 13⅛	...	...
£00,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	122 —127	123 —128	125½	...
200,000	Do. 4½ % 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	103 —106	103 —106	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	4 %	8½— 9½	8½— 9½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	11½— 12½	11½— 12½	12 1/16	12½
£00,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Red.	...	...	...	...	111 —113	11 —114	...	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	7 %	6½— 6⅝	6½— 6⅝	6⅝	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	6 — 6½	6 — 6½	6½	6 1/16
120,000	Do. do. 4½ % 1st Mort. Deb. Stock.	100	...	...	...	107 —110	07 —110	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	11%	12%	10%	10½— 11½	10½— 11½	10⅞	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	1⅝— 2⅛	1⅝— 2⅛	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	...	...	4⅞— 5⅛	4⅞— 5⅛	...	...
£50,000	Do. do. do. 4% 1st Mt. Db. Stock Red.	Stock	...	...	...	96 — 99	96 — 99	97⅛	...
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	6½%	15 — 16	15½ - 16½	16	1 3/16
£20,000	Do. 4½ % First Mortgage Debenture Stock	...	...	...	...	109 —113	110 —115	...	...
£50,000	Do. 3½ % Mort. Deb. Stock Red.	Stock	...	...	...	99 —102	99 —102	101⅛	...
8,652	Notting Hill Electric Lighting	10	7 %	7 %	6 %	13½ - 14½	13½ - 14½	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½—15½	15 — 16	15½	15 3/16
20,000	Do. do. 7 % Pref., 20,001 to 40,000	5	7 %	7 %	7 %	8½— 9½	8½— 9½	...	...
150,000	Do. do. 3½ % Deb. Stock Red.	100	...	...	...	97 —100	98 —101	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	1⅝— 2⅛	1⅝— 2⅛	...	...
58,000	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,900	South London Electricity Supply, Ord.	5	...	...	...	2½— 3	2½— 3	...	...
109,518	Westminster Electric Supply, Ord.	5	13 %	10½ %	10½%	11 — 12	11 — 12	11⅛	11¼

* Subject to Founders Shares.
† Quotations on Liverpool Stock Exchange.
Unless as otherwise stated all shares are fully paid.
‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‡ are for a year, consisting of the latter part of one year and the first part of the next

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years.			Closing Quotation Sept. 9th.	Closing Quotation Sept. 17th.	Business done week ended Sept. 17th, 1902.	
		‡	1899.	1900.	1901.			Highest.	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	10	...	5½%	...	4 — 5	4 — 5	...	...
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	83 — 88	83 — 88	...	...
62,074	British Electric Traction	10	8 %	9 %	9 %	12½ — 13½	12½ — 13½	13½	12½
90,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12½ — 12⅝	12½ — 13	12⅝	12⅝
600,000£	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	124 —127	125 —128	126½	125
70,000	British Insulated Wire Ord.	5	20 %	15 %	10 %	7½ — 7⅝	7½ — 7⅝	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5½ — 6	5½ — 6	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	8 %	...	13s. to 15s.	13s. to 15s.	...	...
50,000	¶ „ „ „ 6 % Cum. Pref.	£1	...	6 %	...	16/6 to 17/0	16/6 to 17/0	...	...
105,731	Brush Elecl. Engng., Ord., 1 to 105,731	2	5½%	5 %	Nil	1 — 1⅛	1 — 1⅛	...	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	3 %	1⅛ — 1⅜	1⅛ — 1⅜	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	100 —103	100 —103	...	...
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	93 — 98	93 — 98	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	20 %	15½ — 16½	15½ — 16½	16½	16
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5⅜ — 6⅛	5⅜ — 6⅛	...	...
90,000£	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	109 —113	109 —113	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	4 %	103 —105	103 —106	104½	104
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	4 %	104 —107	105 — 108	106½	106½
440,100	Do. do. Def. do.	Stock	...	...	4 %	103 —106	103 —106	...	...
855,000	City and South London Railway	Stock	1¾%	1¾%	2 %	72 — 74	72 — 74	72	72
54,000	Crompton & Co., Nos. 1 to 54,000	3	7½%	8 %	7½%	2½ — 3	2½ — 3	...	...
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	...	...	...	...	101 —106 %	101 —106 %	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½%	...	⅛ — ⅜	⅛ — ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	2½%	...	1½ — 2½	1½ — 2	...	...
344,023£	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	74 — 78	74 — 78	...	...
100,000£	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	78 — 83	78 — 83	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1⅞ — 2⅛	1⅛ — 2	1⅞	1⅛
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	2	...	...	...	2⅛ — 3	2⅛ — 3	...	...
182,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	99 —102	99 —102	99	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	5 %	5 %	10 — 10⅛	10 — 10⅛	10 1/16	...
250,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	100 —103	100 — 103	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	20 %	16 — 17	16 — 17	16⅛	16⅛
35,000	Do. do. do. 4½ % Pref.	5	4½%	4½%	...	5⅛ — 5⅜	5⅛ — 5⅜	...	...
50,000£	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	109 —113	109 —113	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	20½ — 21½	20½ — 21½	...	...
300,000£	Do. do. do. 4 % 1st Mort. Deb ...	100	...	...	...	100 —103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¾%	3¾%	1¼%	4⅜ — 4½	4⅜ — 4½	...	...
10,000	† Do. do. Pref., £10 paid	10	5	...	...	9⅜ — 10½	9⅜ — 10½	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500 ...	10	...	...	...	14½ — 15½	14½ —15½	...	...
	§Roaling & Fynn 6 % Cum. Pref.	£1	...	6 %	...	... — ...	19/0 to 20/0	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	20 %	38 — 41	38 — 41	39	...
150,000£	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	... %	...	...	102 —105	102 —105	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	90 — 93	90 — 93	91½	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ⅞—1.
National Electric Free Wiring, —1.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14½—15.
Do. do. Pref. (£10 pd.), 10⅝—10¾.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (February 6th, 1902).

MARKET QUOTATIONS, Wednesday, September 17th.

CHEMICALS, &c.		This week.	Sept. 3rd.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	28/-	28/-	..
a „ Oxalic	per cwt.	80/-	80/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Gal	per cwt.	42/-	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a „ „ „ ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£13	..
a Benzole (90 %)	per gal.	1/-	1/-	..
a „ (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£19	£19	..
a Lead, Nitrate	per ton	£34	£34	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£57 10	£57 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	6d.	6d.	..
a „ Caustic (76/84%) ..	per ton	£34	£34	..
a „ Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	100/-	103/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5	£6 5	..
a „ „ Recovered	per ton	£5 10	£5 10	..
a „ „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 76 %) ..	per ton	£10 15	£10 15	..
a „ Crystals	per ton	£5	£5	..
a „ Bichromate, casks ..	per lb.	4½d.	4½d.	..

METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£140	£140	..
b „ Wire, in ton lots	per ton	£204	£204	..
b „ Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£40 to £140	£40 to £140	..
c Brass (rolled metal 9" to 15") basis	per lb.	6½d.	6½d.	..
c „ Tubes (brazed)	per lb.	8½d.	8½d.	..
c „ „ (solid drawn) ..	per lb.	7d.	7d.	..
c „ Wire, basis	per lb.	7d.	7d.	..
c Cannon Tubes (brazed) ..	per lb.	8½d.	8½d.	..
„ „ (solid drawn) ..	per lb.	9d.	9d.	..
p Copper Bars (best selected) ..	per ton	£69	£69	..

METALS, &c. (*continued.*)		This week.	Sept. 3rd.	Inc. or Dec.
p Copper Sheet	per ton	£69	£69	..
p „ Rod	per ton	£69	£69	..
c „ Electrolytic) Bars ..	per ton	£68	£68	..
c „ „ Sheets ..	per ton	£75	£75	..
c „ „ Rod	per ton	£69	£69	..
c „ „ H.C. Wire	per lb.	8d.	8d.	..
f Ebonite Rod	per lb.	2/-	2/-	..
f „ Sheet	per lb.	2/-	2/-	..
m German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	2/-	2/-	..
h India-rubber, Para fine	per lb.	3,2to3/4	3,1	inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants) ..	per ton	53/7½	53/6½	7d. dec.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i „ Wire, galvanised No. 8 ..	per ton	£9 15	£9 15	..
p Lead, English Ingot	per ton	£11 2 6 to £11 5	£11 2 6 to £11 5	..
p „ „ Sheet	per ton	£18	£18	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
p Mercury	per bot.	£8 15	£8 15	..
d Mica (in Original cases), small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large ..	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	11½d. to 1/2	11½d. to 1/2	..
p „ rolled bars & rods	per lb.	1/- to 1/3	1/- to 1/3	..
p „ „ strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£4	£4	..
p Silicium Bronze Wire	per lb.	9d. to 1/-	9d. to 1/-	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	From £15 to £40	From £15 to £40	..
i „ „ in bars		£68	£68	..
p Tin, block	per ton	£121 to £122	£125 to £126	£4 dec.
p „ foil	per lb	1/6	1/6	..
n „ wire, Nos. 1 to 18	per lb	1/7	1/7	..
p White Anti-friction Metals —				
"White Ant" brand	per ton	£26 to £60	£26 to £60	..
f Yarns, 2/16s Grey Cotton, on sp'n	per lb.	7d.	7d.	..
f „ 2 lea. Flax	per lb.	5¾d.	5¾d.	..
f „ 2 ply 16 lbs. Russian ..	per lb.	6¼d.	6¼d.	..
f „ 10 lbs. Russian, single ..	per lb	4½d.	4½d.	..
f „ 180 lbs. Jute rove	per ton	£11 15	£11 15	..
b Zinc, Sh'ts. (Vieille Montagne brd.)	per ton	£18	£22	..

Quotations supplied by
a Messrs. G. Beer & Co.
b The British Aluminium Co., Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons.
e Messrs. Frederick Smith & Co.

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f India-Rubber, G.-P. and Teleg. Works Co., Ltd.
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p The Phosphor Bronze Company, Ltd.

BRITISH ASSOCIATION, BELFAST, 1902.

THE FUTURE OF THE TELEPHONE IN THE UNITED KINGDOM.

By J. E. KINGSBURY.

To the members of the British Association the telephone and its applications cannot fail to be of interest, for they must ever recall with pride that it was at the Glasgow meeting of the Association in 1876 that Alexander Graham Bell's invention was first introduced into this country by the Sir William Thomson of that time, and the Lord Kelvin of this. The telephone then was a scientific marvel, and attention was centred on its improvement as a talking instrument. Some of its possibilities were foreshadowed, but its principal application was not foreseen. The meeting of the Association at Sheffield in 1879 coincided with the opening in London of telephone exchanges. From that time the science of the telephone has been the science of telephonic intercommunication.

Like all the more recent practical applications of scientific principles, it is in itself a composite art calling to its aid not only acoustics and electricity, but of late years more particularly, the heavier branches of mechanics and engineering, since the modern telephone exchange has anticipated the power schemes by producing at one centre the electrical energy required to signal and to talk between thousands of stations over lines mostly placed underground at a considerable cost, and requiring much engineering skill. Any one of the elements of this composite art would afford interesting subjects for discussion. But they have been and will be dealt with elsewhere and at other times, and will be only very casually touched upon in this paper. The future progress of the telephone in the United Kingdom does not depend upon scientific developments, but upon common sense. In this it does not differ from most engineering questions, for I take it that engineering is a means to an end; that an engineer would derive little satisfaction from the construction of a bridge, however beautiful its proportions, if the approaches rendered it of no utility.

There are at the present time some impediments on the approaches which need removal. They are of a political, economical, and social nature, and they exist, as I think, largely on account of the lack of public recognition of the peculiarities which differentiate a telephone exchange system from other works of practical utility. It is my object in this paper to attempt to remove some of the popular misunderstandings which undoubtedly exist, and by placing before you some of the features upon which telephone service depends, draw some conclusions as to its future. You will, of course, be prepared for a considerable dip into the past and some reference to the present before the future is reached.

It is necessary to bear in mind that in 1870 various companies undertaking the transmission of telegrams were acquired by the State, and the work which they undertook was combined with that of the Post Office. The Act of 1869 extinguished competition in telegraphs, and conferred on the Postmaster-General the exclusive privilege of transmitting telegrams. The Post Office had been carrying on this business for six years when the telephone was invented. Its development and application to purposes of profit in the United Kingdom took another three years, so that telephone exchange companies began operations in London in 1879. The Post Office claimed that the service rendered by the telephone companies was an infringement of the powers conferred on the State by the Telegraph Act of 1869. The telephone companies contested this claim, but it was decided in favour of the Post Office in the suit of The Attorney-General *v.* The Edison Telephone Company of London, Limited, tried before Mr. Baron Pollock and Mr. Justice Stephen in 1880.

The reasonableness of the decision is even now sometimes questioned, mainly because the Act was passed in 1869 and the telephone invented only in 1876. But distinction needs to be drawn between (1) a service which the State reserved to itself the sole right of undertaking; and (2) improvements in apparatus for, or in the means of carrying out, that service.

The service reserved by the State was the transmission of telegrams, and in Mr. Justice Stephen's very careful judgment, he shows that within the definition of the Act of 1869 "any apparatus for transmitting messages by electric signals is a telegraph whether a wire is used or not, and that any apparatus of which a wire used for telegraphic communication is an essential part is a telegraph, whether the communication is made by electricity or not." Thus the telephone was only an improvement in, or an accessory to, the service of which the State held a monopoly.

Counsel for the company gave notice of appeal, and the Attorney-General, on behalf of the Crown, stated "that of course the Postmaster-General is fully alive to the advantages derived by the public from telephonic communication, and whatever result this litigation may lead to, care will be taken in the interests of the revenue, and also in the interest of the public, that nothing shall be done to stop telephonic communication so far as it is required by the public." This statement foreshadowed the policy which the Government considered it advisable to pursue, viz., to work telephone exchanges through the medium of private organisations or public companies acting under license. Licenses were issued for a period of 31 years conditional on payment of 10 per cent. of the gross receipts. An indication of the Government's intention to resume the working of the system at some period is given by a condition of the license that the Government were to have the right to purchase the licensee's business at septennial periods upon giving six months' notice, and subject to arbitration in event of disagreement on price. The first licenses limited communication to four or five miles from a defined centre, the State providing trunk lines between the areas. The limitation was found to be inconvenient. It was removed in 1884 and trunk wires between towns were erected by the companies. In 1896 the trunk wires were purchased by the Post Office and the companies' work limited to "telephone areas" based on the requirements of localities.

Efforts have been made to obtain a reduction in the Post Office royalty, which has been denounced at various times, and has been complained of as a tax on communication, as the newspaper stamp was denounced as a tax on knowledge. But even the sufferers by it did not universally condemn that objectionable tax, for Addison, in the *Spectator* of the day preceding the application of the stamp, intimated that he would glory in contributing his utmost to the public weal, and remarked that, "It is a received maxim that no honest man should enrich himself by methods that are prejudicial to the community in which he lives, and by the same rule I think we may pronounce the person to deserve well of his countrymen whose labours bring more into the public coffers than into his own pocket." In this mildly ironical way did Addison convey the information that of the price paid by the purchaser one-half went into the public coffers. The telephone royalty is more moderate, and it cannot be said that the labours of the Telephone Company put more into the Treasury than is distributed amongst their shareholders, but the amount is a substantial one, for during the last 10 years the company has paid in Post Office royalty £916,000 in round figures. For the past year the royalty was about £150,000. The royalty is a part of that protection of the revenues of the State to which the Attorney-General referred, and so far as the companies are concerned, it may be regarded as a payment by means of which they are enabled to earn dividends, since, without a license, it would not be possible for them to undertake the business at all.

The Post Office not only reserved the right to compete, but in some places actually did compete, and in others granted licenses freely to competing companies. The inference to be drawn from their attitude is, that they were careful not to create a monopoly outside themselves, regarded freedom of action as tending to the public benefit, and were satisfied to let ordinary laws work out the solution of the problem so long as their sovereign rights were maintained and their tribute paid. The service was a new one, there had been no previous experience of its working and no reasonable forecast could be made.

The competition which existed between the Bell Company and the Edison Company in 1879 ended by the amalgamation of the two into the United Telephone Company in 1880 before any considerable work had been done; and resulted rather from the advantage of combining patent rights than extinguishing any extensive business competition. But as a subscriber to the Edison Company, I am able to bear witness to the advantage of the increased capacity of communication which resulted from the amalgamation, small as that would seem now. Shortly after the amalgamation a company called the London & Globe Telephone Co. established an exchange in London, proposing to charge a reduced rental of £12 per annum, instead of £20, the rate then ruling. The company discontinued its operations after a few hundred subscribers had been connected, because it was unable to obtain instruments free of the Edison patent. As a subscriber to the London and Globe Company, I can also speak from experience of the advantage of the reduction in telephone subscriptions which resulted from the cessation of a duplicate service. The other principal competitive exchanges during the patent era were at Dundee and Sheffield, and in anticipation of the expiry of the patents, an exchange was started in Manchester by the Mutual Company.

The Dundee Company was purchased by the National Telephone Company at an early stage in its career; the Sheffield Company was eventually absorbed, and the Mutual Company lived but a comparatively short period.

The popular view of these amalgamations is well known. The real reason has been overlooked. Before formulating it, I will ask you to consider what a telephonic conversation is, and how it is obtained?

Let me make a comparison between telephone exchange service with which we have been familiar for a little more than 20 years and other services which have existed for much longer periods.

There are no longer any competing telegraphs in England, but let us suppose there are. I desire to send a telegram to any town. I can take my choice of lines. There is no restriction whatever on the delivery of my message to any inhabitant of that town I may desire to communicate with. In the same way I may take advantage of railway competition by choosing the cheapest or quickest route, or I may prefer to take the longest or most expensive route on account of its natural beauties. What would be thought of the advantages of a railway competition from London to Liverpool if the latter city were divided into two portions, and it were ordained that for a destination on one side of St. George's Hall it would be necessary to travel by the North-Western, and for a destination on the other side by the Midland Railway. Let us suppose the issue of season tickets. With one season ticket a passenger would be able to reach one-half of Liverpool. If he desired to reach the other half as well he would require two season tickets, and would need to take a different route for either destination. By the division I do not mean a policeman outside the station to direct your cabman by a given street which order he can evade at the next turning. You must please to imagine an impenetrable barrier. You regard this undoubtedly as a preposterous proposition, but it is exactly analogous to the conditions prevailing under competition in telephony. There are a restricted number of possible correspondents for distinct services or double season tickets if you

wish to enlarge your area of communication to the fullest possible extent.

The reason why competing services have ceased in the past, is because the absurdity of such a situation becomes obvious when put in practice.

Let us see how the subscribers of the lapsed companies fared in the combinations which have been made. The Dundee Company, at the time of the amalgamation, had 332 subscribers; 152 of these subscribers belonged to both companies, and thus had two season tickets. Each subscriber to the local company paid £5 10s. per annum. He thus paid 3·975d. per annum each for the opportunity of communicating with 332 subscribers. On amalgamation the subscriptions of the 152 were slightly reduced, and of the 180 largely increased, but the annual cost of the right to speak with each other subscriber was reduced from 3·975d. to 2·919d., and with the increase in subscribers this reduction was continually growing in favour of the original subscribers. In addition to the larger number of possible correspondents in their own locality, the amalgamation gave the subscribers to the local company access to other localities, thus adding considerably to the value of the telephone to them. The influence of a widespread "telephone net"—to adopt a Continental expression—may be compared with the force of gravity. Sooner or later the smaller local body if it do not evaporate altogether must be attracted to the larger body. And if the repellant force natural to competitors should retard unduly the operation of this attractive force, then the latter will inevitably be assisted by some superior power in the interest of the public weal, for it must be remembered that the proprietors of exchanges and the subscribers thereto are not the only people concerned. The general public experience some of the drawbacks of this competition. As an example, I may cite an instance from Scandinavia—a part of the world frequently referred to in connection with the advantages of competition in telephony. About the time of the competitive services in Dundee, rival companies were giving the citizens of Christiania the same advantages when (August 20th, 1884), "The Municipal Council resolved, in accordance with the proposal of the Executive Committee, to notify the International Bell Telephone Company, and the Christiania Telephone Association, that after two weeks they shall not be allowed to run new telephone lines over the public streets, squares, &c., and the Council appointed Messrs. Birch, Reichenwald, Anderson and Christopherson to aid the Executive Committee in negotiating with the telephone companies an amalgamation into a single company." The round-table conference succeeded in its efforts, the competition ceased, the number of subscribers grew rapidly, and the exchange has since been acquired by the Government.

The experience of Dundee was not repeated in the United Kingdom for a number of years, because the National Telephone Company were protected by patent rights. On the expiry of the patents, a number of public-spirited citizens of Manchester combined to remove from their town the stigma of being dependent on a telephonic monopoly, and to demonstrate to their predecessors of Dundee the iniquity of being bought up at a profit. They formed the Mutual Telephone Company, of Manchester.

The Mutual Company was in due course acquired by the National Company. At the time of the amalgamation, 492 of the 1,349 subscribers of the Mutual Company also subscribed to the other company. The ratio of subscription to number of subscribers, that is, the cost of the opportunity to communicate was 1·320d. per subscriber per annum. On amalgamation it was reduced to ·567d.

In the Parliamentary Committee Report of 1895 it is shown that the average payments of the Mutual subscribers were £7 8s. 6d. per annum. The average rate of the other company is not given. The normal rate was £10. The average would probably be slightly higher. The total payments by the people of Manchester before and after amalgamation were approximately as follows:—

Before amalgamation:—

National	3,374 at £10	0 0	£33,740
Mutual	1,349 at 7	8 6	10,016
	4,723		£43,756

After amalgamation:—

Combined subscribers	4,723		
Less duplicates ...	492		
	4,231 at £10	0 0	£42,310

Whilst the latter total is lower, yet in the absence of definite information as to the National Company's average the figures must not be taken as more than an indication that, to the then existing subscribers, there was no very material change in the total cost of the service.

But this, even if admitted, does not go far with the advocates of competition. The contention is, that the lower rate was a paying rate, and that all subsequent subscribers have been overcharged by reason of the absence of competition.

The claim that the lower rate was a paying rate is based on the assertion that, during the existence of the competing companies, they were able to make both ends meet. I neither confirm nor combat the assertion, but I wish to correct an impression which is very natural to the mercantile mind. It is that on the fixed subscription plan every additional subscriber is a monetary gain.

A new subscriber adds to the working expenses, in that he not only makes calls himself, but increases the calls of other subscribers. With the growth of the exchange there is an increase in the apparatus or plant used in common, such as junction wires and switchboards, as well as in the number of operators. Hence, with the same class of equipment, the increase in subscribers leads to a disproportionate increase in cost of plant and working expenses.

The reason why the working costs at the present time are not considerably higher than in earlier years is, because the class of equipment is not the same. Improved appliances have been introduced, additional plant has been erected or old plant reorganised, enabling the work to be done more economically.

But these improvements have cost money, and it will at once be seen that upon these early exchanges, which are so often referred to, further expenditure would need to have been made without an increase in revenue, and from this may be seen the importance of making an allowance for depreciation before arriving at the cost of the service. Depreciation in telephone plant must not be confounded simply with the wear and tear of ordinary machinery. Certain portions may be claimed to be practically indestructible in themselves and yet require considerable depreciation allowance. This arises from the changes caused by growth whereby plant is displaced even though capable of continued use. No rule can be laid down for universal application. There are instances of 5 per cent. and of 15 per cent. being allowed, but the medium figure is more general.

As I have said, the real lesson of the amalgamation was never learned. The apparently profitable nature of telephone enterprise, the invariable maintenance of the rates at the higher level, conveyed an impression which has been sedulously fostered that the absorbing telephone companies were simply seeking, in Addison's words, "to enrich themselves by methods that were prejudicial to the community," and Parliament determined by the Act of 1899 to develop, by the aid of the ratepayers, that competition which had so far failed under private enterprise.

Two municipalities, Glasgow and Tunbridge Wells, have taken advantage of the permission, and history is repeating itself in its usual way.

The first annual report of the Telephone Committee of the Glasgow Corporation shows that £192,693 14s. 3d. has been spent in equipping an exchange for 5,494 stations. "The stations are subscribed for by 4,697 persons and firms; of these 2,059 have never been telephone subscribers before." This may be taken to mean that all the other subscribers to the municipal exchange are also subscribers to the company's exchange. The average capital expenditure per person or firm (not per station) is £41, but the total expenditure includes work which is very properly undertaken in advance of requirements, and it is a reasonable inference that with a comparatively small additional expenditure sufficient subscribers could be added to reduce materially the above average. It is futile to take only the cost of the useable lines, because there always will be considerable excess. I want only to make a comparison between the useful and the useless expenditure. At a capital outlay of £35 each, 2,059 new subscribers give a useful expenditure of £72,065, and 2,638 a useless expenditure of £92,330. It is not necessary for me to suggest how very much more useful that useful expenditure would have been if it had widened the field of the new subscribers.

In Tunbridge Wells the same results of duplicate subscribers and duplicate subscriptions are found, as was inevitable.

The necessity of anticipating demand, and the supply of plant largely in excess of that actually used, is inherent in telephone service. Conduits in anticipation of cables, cable in anticipation of subscribers, switchboard equipment in excess of immediate requirements; all these necessarily exist in any well-planned exchange.

Every subscriber must bear his proportion of the excess, since, of the revenue obtained from the subscribers, a portion must be devoted to interest on capital. Duplicate the system, and, if they are equally well planned, you double the surplus plant, the capital expenditure therefor, and the subscribers' burden thereon.

Compare the action of these municipalities with the admirable arrangement concluded by the Postmaster-General in London, where every subscriber to the Post Office system is in communication with all the 40,000 subscribers to the previously existing system, so that duplicates are unnecessary and no expenditure is wasted. Competition is a check—a means of preventing undue profit being made by the producer of a commodity or the supplier of a service, and the maintenance of the check requires the continuance of the competition. Technical advocates of competitive telephony realise its temporary character, as will be seen from the published report of the Glasgow engineer recommending another English municipality to undertake competitive service. Dealing with the question of intercommunication between the rival exchanges, he says, "Intercommunication locally from the beginning would render the development of the Corporation exchange difficult . . . . But when the Corporation's exchange has become larger the conditions will be reversed . . . . On reaching that point, intercommunication might be insisted upon by the Corporation with every advantage, for the effect would be to complete the ruin of the opposition system."

It might be argued that it is not the province of a municipality to "complete the ruin" of an enterprise rendering a useful service to any of its ratepayers. It might be suggested that the attempt to destroy sometimes results in being destroyed, but I prefer rather to approach the consideration of municipal telephones in a spirit of sympathy with the municipal ideal, and a realisation of the advantages which may sometimes be obtained by collective effort. It is not surprising that, in the absence of an accurate conception of the nature of telephone exchange work, a municipality should be regarded as a suitable body to undertake it. The first idea that occurs to one is that the municipality is the local authority, and yet as applied to a telephone area a municipality is only one of several authorities, for whilst the business centres throughout the kingdom

have grown, the municipalities remain to a very large extent simply extensions of the old parochial system, and the extensions have not been carried far enough. The telephone area is the whole district over which the business and social relations of the locality naturally flow, but in its flow it covers numerous ownerships. There is no rivalry equal to the rivalry of neighbouring municipalities; there is not a common interest, and in the absence of identical interests, there is difficulty in obtaining agreement in policy or on the details of carrying out a policy.

Agreement may sometimes be obtained as the result of an enthusiasm against what is regarded, rightly or wrongly, as a common foe; it may be continued while the contest lasts. Assume that the ruin of the opposition is completed, will the cohesion continue? Localities change their condition. The fashionable quarter to-day is the business quarter to-morrow. It is the interest of the outlying district to develop its resources. It is the interest of the older and larger municipality—the predominant partner in the telephone area—to retain its prestige, to prevent the development of its rivals. The telephone will be an important factor in such rivalries. Unless it be in independent hands it is easy to foresee a splitting up into smaller units, adding to the confusion, increasing the cost, and generally working to the detriment of the service.

The successful supply of electric light, for example, by municipalities must not be regarded as any criterion of a similar result in the case of telephone exchanges. An electric light station contains a producing plant, the streets carry distributing mains, the service is from the centre outwards, and the entire plant from centre to extremities is under one control. A policy may be initiated and enforced without regard to outside considerations. Telephone exchange service, on the other hand, requires that the system should work in with other systems.

Traffic between two places calls for provision for outgoing calls at one exchange and provision for incoming calls at another exchange. Independent views at either exchange are incompatible with successful working. Neighbouring municipalities running tramway services might so arrange that there could be no through communication, but the inconvenience occasioned to the passenger would be only that of stepping out of one car into another. The equivalent in telephone service would be the stoppage of communication altogether.

One of the arguments urged for local control is that a large percentage of conversations are local. But compare the value of a local conversation with a long-distance conversation, and it will be seen how important it is that no impediment, either of an engineering or administrative nature, should be placed in the way of such communications. Experience shows an almost inevitable tendency to local or individual preferences, both in the way of engineering and management; and experience shows also not only the practical difficulties arising from such preferences, but also the greater difficulty of applying a remedy.

It is sometimes assumed that competition is necessary in order to increase the number of subscribers; I will give an example of phenomenal increase without competition. On January 1st, 1894, there were about 10,000 stations in New York. On January 1st, 1902, there were 72,189 stations in only a portion of the area which was included in the 1894 figures. This considerable increase over the previous progress is attributed to the adoption of a rational system of charging. Up to 1894 there was a "flat rate," the same subscription for large user and small user. In 1894 the message rate system was applied, with the result that the telephone service has become available to the small user, and enormously increased in value to all subscribers by widening the field of communication. This method has also been adopted for the Post Office system in London. It was proposed for adoption some years ago by the National Company, in Sheffield, but the subscribers rebelled against it.

I have remarked on the extent to which the future has to be anticipated by present expenditure. Each new subscriber involves capital outlay, and new present work invariably includes some margin for future use.

The amounts expended during the past five years in adding to the exchange construction and equipment of existing services by similar organisations in the United Kingdom and the United States compare as follows:—

	National Telephone Company.	Licensees of American Bell Telephone Company.
1897 ...	£460,937	£973,063
1898 ...	682,506	1,489,499
1899 ...	742,151	3,189,892
1900 ...	834,772	4,382,908
1901 ...	536,793	4,400,000
	£3,257,159	£14,435,362

In making these comparisons, I wish rather to draw attention to the yearly growth than to compare the totals. In the United States there is considerable growth in new expenditure from year to year. In the United Kingdom there is a fairly gradual increase to 1900, and a decrease for 1901. The difference suggests some reason.

I think it will be found in the fact that in the United States the companies supplying the service have no limit to their existence. In the United Kingdom the company supplying the service dies in 1911, or, to put it more accurately, its right to continue the business dies then. To the Parliamentary Committee of 1898, Mr. Forbes stated that it would be the policy of the company not to embark on new expenditure after 1904, but to maintain their existing system in the best condition till the expiry of the license in 1911. By the Telegraph Act of 1899 it is provided that the licence of the National Company shall be extended in those areas in which competitive services are started, the restrictive barrier against intercommunication being gradually broken down. With longer life the hesitation to undertake further expenditure disappears, for the longer period in which returns may be obtained warrants new investment by the company.

Corporations can borrow easily and cheaply. We thus have financially a most anomalous situation. Money can be spent on competitive systems, which are the most wasteful, which give the maximum of inconvenience with the minimum of public benefit, but money cannot be spent on developing the existing system to which additions can be made at a minimum of cost with a maximum of benefit. The future of the telephone depends very much on the present, for equipment for present subscribers includes some provision for future subscribers, and present starvation means future weakness.

The engineering and construction work should be on a scale that provides for considerable growth, and of a kind that will give reasonable expectation of satisfactory results when that growth is attained. On sound financial principles work on such a scale cannot be undertaken on the terms of existing licenses. The best that could be expected with a sole tenant is a reasonable surplus on present requirements. The best that can be expected from competitive services with unremunerative rates and short tenure is hand-to-mouth construction work and speedy dilapidations.

The existence of duplicate services designed and operated without regard to one another necessarily means that on the expiry of the licenses it may be found better and cheaper for the State to lay down a new system than to attempt to combine the existing ones. I regard it, however, as extremely doubtful whether competitive systems will continue to the end of the license. It seems to me that the result of the competitions now in progress may be easily foretold. I venture the suggestion that competition by municipalities was provided for under a misapprehension of the nature of telephone exchange service, and a misconception of the results, direct or indirect, which might be expected. I venture further the suggestion that those municipalities which have undertaken such competition have done so under a mistaken view of the benefits to be obtained and the cost of obtaining them. But I have too great a faith in public opinion to doubt that as the lessons are brought home the result of existing competition will be the same as previous competitions. Duality will give way to unity as the only reasonable method of conducting the work. Unfortunately the disadvantages must be apparent and realised before they are regarded, and probably much expenditure will be incurred before the mistake is recognised. In the meantime the future progress in the practical use of the most beautiful and most useful application of science which the past century produced will be seriously impeded.

The "removal of any disadvantages of a public kind which impedes the progress of science," is one of the objects of the British Association. The impediment is so much of a public kind as to be fraught with peculiar difficulties, and to involve important considerations of imperial and local politics which are out of our province. I can only hope that the subject may be considered solely from the point of view of the "public weal," and that scientific inquiry may have some share in reaching conclusions. If that be the case, I do not hesitate to express my own belief that the future of the telephone in the United Kingdom will be free from competition, free from the expense and waste of war, developed by the certainty of permanent utility, and cheapened by the economy which unity of control and permanent work will attain.

THE APPLICATION OF ELECTRIC POWER IN THE IRON AND STEEL INDUSTRIES.*

By D. SELBY-BIGGE (Newcastle-on-Tyne).

In the year 1894 the author had the honour of reading before this Institute two papers dealing with the subject of Electric Power Transmission, having regard especially to the driving of works machinery by means of electricity. At that time the subject was a comparatively new one to the owners of works in Great Britain. The papers read were purely of a technical nature, and dealt with the methods the author then thought most suitable to be employed in driving works electrically. Since that date a great number of papers have been read by well-known authorities on this subject. In bringing another communication before this Institute it is now the author's endeavour to read a paper on somewhat different lines, and one which will prove not only of interest but of actual use to works owners and managers in England. The paper therefore will deal chiefly with actual facts and figures, and with data of a practical nature, collected from a great number of different sources.

During the past 12 years the author has been almost exclusively engaged in the remodelling of the driving arrangements in engineering works, iron and steel works, shipyards, factories, and mining operations from steam to electricity, and he has almost invariably been met with the question—Can you show us by any facts or figures actual savings which can be directly attributable to the change from one system to the other? It has not, however,

* Paper read before the Iron and Steel Institute at Düsseldorf, September, 1902.

been possible for him to deal with this matter in the form of a paper until the present time, as in the early days no data were available, and even in subsequent years accurate data have been most difficult to obtain. The following cases and figures may, however, prove interesting to the members of this Institute.

Savings Effected in Works.—For the Hamburg quayside cranes the total working expenses were as follows:—Wages for cranesmen, coal or electric current, cleaning and oil (excluding, however, repairs) per 10-hour run per crane, taking the average during the year:—

	Cost per 10-hour run.	
1. Brown single-steam crane ...	10s.	
2. Steam-winch crane	8s.	1893—94
3. Steam crane driven through pipes from steam plant ...	12s.	
4. Electric crane	7s.	1898

The steam cranes are stoked with cinders only, which in 1893—94 cost about 11d. per cwt. The electric cranes take current from the public supply at about 2d. per KW.-hour. (1) and (2) have a boiler on the crane itself; (3) takes steam from a larger steam plant through pipes (about 20 are thus supplied).

In 1901 the working cost of 182 Brown's cranes came to 11s. 4d. per crane per 10-hour run, whereas that of the electric cranes was the same as in 1898, viz., 7s.

In 1898 the steam cranes lifted 1,825,880 tons in 315,083 hours; the working costs amounting to £20,516 4s., so that the cost per hour (inclusive of repairs) amounted to $\frac{410,324}{315,083} = 1.302$ shillings, or about 1s. 4d. per working hour. The cost per ton lifted would be 0·2247 of a shilling, or nearly 2¼d.

The electric cranes lifted from January 1st, 1898, to September 30th, 1898, 77,697 tons in 10,190 working hours, the cost being 2,664 shillings for current (2d. per KW.-hour) and 4,462 for wages, &c. Thus for 1 ton of goods lifted, the cost is nearly 1d.

Taking next the case of the Westinghouse Air Brake Company, Wilmerding, Penn., U.S.A., the boilers in this shop were formerly driven in groups, 30 steam engines, aggregating 1,375 H.P., being used for the purpose. The engines were supplied with steam from the central boiler plant. For this system was substituted an alternating current system, the generators supplying induction motors driven by Parsons steam turbines; the shafting used was divided into shorter lengths, and the 30 engines were replaced by 57 motors, aggregating 1,065 H.P. In order to have an accurate comparison of the two systems, several tests were made, extending over some days, with the following results:—The reduction in steam consumption was found to be 40 per cent. and the reduction in coal consumption 32½ per cent.

Before a meeting of the Franklin Institute in 1901, Mr. Samuel Vauclain, superintendent of the Baldwin Locomotive Works at Philadelphia, U.S.A., stated that if electric driving in their works should be abandoned the manufactured product would cost 20 to 25 per cent. more for labour, and the floor space would have to be increased 40 per cent. to maintain the present output.

In an excellent article written by Mr. Alexander Richardson, upon Messrs. Vickers, Sons & Maxim's works at Barrow-in-Furness, and published in the July number of *Traction and Transmission*, he says:—

"No special data have been taken as to the cost of running this station separately, but it may be noted that the cost per unit generated during 1901 at the engineering works station was 0·77d., which includes coal, wages, water, repairs, and all works cost. The economy resulting from the substitution of electric power for steam is shown by the fact that the average monthly coal consumption for three winter months in 1898, when only steam-power was used in the shipyard, was 476 tons, whereas for the corresponding period in 1899, after electric power was adopted, the average coal consumption was 232 tons, being almost exactly half the total required for steam-power. This, too, notwithstanding the fact that many new machines had in the interval been added in the platers' shed, and that the amount of lighting done had been more than doubled. The true saving is probably nearer 60 per cent. than 50 per cent. if this extra load be taken into account."

At a large colliery in South Durham the pumps were originally of the spear rod type, worked from bank, and the pumps delivered about 1,000 gallons per minute against a head of 400 ft.

Owing to the room which these pumps occupied in the shaft, and it being desired to put in another cage, which could not be done with the pumps in the shaft, the pumps were removed, and in their place was substituted a horizontal compound-coupled engine of 400 H.P., one 250-KW. dynamo arranged to drive the two pumps at present installed, also an additional pump, and the coal-cutting machines.

This machinery was placed at a colliery where they were able to utilise coke oven gas. The colliery being 1,000 yards from the shaft where the pumps were originally installed, the current was carried overhead by cables and down the shaft to two sets of 11 × 18 three-throw pumps, each delivering 500 gallons per minute against a head of 400 ft.

It is estimated that the saving in fuel alone is over £1,500 per annum; in addition to this the shaft can now be used for winding, and the output of the colliery is very considerably increased.

In one of the collieries in Northumberland the workings were pumped by means of seven single-barrel pumps, each set delivering about 100 gallons per minute, these pumps being driven by an endless wire rope from two hauling engines, steam being supplied by locomotive boilers underground.

This plant was taken out, and in its place was substituted a horizontal engine with automatic triple-expansion gear driven on to a dynamo, and the existing pumps were utilised, the pumps being driven through machine-cut worm gear by 6-H.P. motors, and in all eight sets were so arranged.

The total cost of the electric plant, exclusive of erection, was a little over £3,000, and the annual saving was from £1,500 to £1,800.

At a colliery in Scotland in which the workings were originally drained by means of:—(*a*) a spear rod pump to the shaft bottom; (*b* and *c*) two duplex pumps underground with steam pipes, the furthest pump being about 800 yards in-bye, it required seven men to attend to the pumps, and the consumption of coal was about 14 tons per day. This plant was taken out, and in its place there was installed a horizontal compound-coupled engine of 250 H.P., a 130-KW. dynamo, one set of three-throw pumps 11 × 18, delivering 500 gallons per minute against a head of 600 ft., and one 150-H.P. motor for driving same. The work with the new plant was done in eight hours per day, the consumption of coal was 2½ tons per day, and the whole installation was looked after by three men. It was estimated that the annual saving exceeded £3,000, so that the total cost of the plant, including erection and everything, would be paid for in less than two years.

With electrical driving of hauling gear at the Ewald Colliery, Germany, it has been found that, not taking into account depreciation, discharging 1 ton kilometre of coal from the mine costs about 3·39 pfennigs (one-third of a penny).

A balance-sheet for July, 1895, shows a clear saving in cost against that of July, 1894, of 5,512 marks, the economy being effected by the electric hauling gear.

The quantity of coal discharged up to July, 1894, for 25 working days amounted to 107,000 truck kilometres, at 0·6 of a ton per truck, 50 horses being at work, so that the monthly work of each horse amounted to $\frac{107,000}{50}$ = approximately 2,140 truck kilometres, or 2,140 × 0·6 = 1,284 ton kilometres, without counting trucks carrying bricks, wood, or lime, or running empty.

The daily work of each horse was $\frac{2,140}{25} = 85·6$ trucks per kilometre, or $\frac{1,284}{25} = 51·36$ ton kilometres.

The monthly cost per horse is as follows:—100 marks paid for hiring; 54 marks, wages for driver, proportion of expenses for stable boys, &c., together, 154 marks for 50 horses; therefore = 7,700 marks, not counting 6 marks per horse, or 300 marks per month for 50 horses for shoeing, water, and amortisation of the underground stables.

If, therefore, the daily work of the horses is 85·6 trucks per kilometre, there would be 51·5 horses necessary for the month of July, 1895, for the whole transport of 118,962 truck kilometres in 27 working days, which would mean a cost of 51·5 × 154 = 7,931 marks.

Exclusive of amortisation of the capital, the cost of the mechanical hauling gear is as follows:—

		Marks.
1	Foreman	190·00
2	Day attendants	197·75
4	Night attendants	473·45
3½	Men for rope repairs	328·07
175	Different amounts for extra work, &c. ...	562·15
	Total of wages	1,751·42
	Extra expenses	145·82
	(320 volts, 110 amps. = 35·2 KW.) for the steam engine $\frac{35·2}{0·7} = 50·3$ H.P.	521·51
	(1 H.P.-hour = 0·024 marks monthly, 27 days × 16 hours × 50·3 × 0·24 = 521·51 marks.)	
	Total working costs	2,418·75

Not taking into account depreciation and interest, in the month of July, 1895, there would be a saving of 7,931 marks − 2,419 marks = 5,512 marks against the same month of the year before.

That amounts to $\frac{7,700·0}{107,000 × 0·6} = 12$ pfennigs (1·2 of a penny) per ton kilometre if worked by horses, and for the mechanical hauling gear $\frac{2,418·73}{118,962 × 0·6} = 3·39$ pfennigs (one-third of a penny).

The cost of amortisation will no doubt be balanced on account of the saving of 51·5 × 12 = 618 cubic metres of fresh air per minute for nine horses, because of the reduction in costs for repairs, &c., and above all, on account of the greater regularity of working.

If, therefore, it is desired to fix the working cost at, say, 150,000 marks for running expenses, inclusive of reserves, 2,250 marks per month, 18 per cent. for amortisation and interest would have to be taken into account, and thus raise the total cost for the mechanical working to 2,419 + 2,250 = 4,669 marks per month; or, in other words, a ton kilometre would cost $\frac{4669·0}{713·772} = 6·54$ pfennigs (a little more than one halfpenny), amounting only to half the cost of working by horses.

A good example of the great difference in cost of working will be found in the statement that the total cost of transporting one ton 3,280 ft., if electricity is used, amounts to only 0·3 of a penny whereas if horses are used, the cost amounts to 1·2 of a penny.

The majority of us do not realise the great losses in driving shafting, with all its bearings, pulleys, gears, and ropes; it amounts to several millions of horse-power every hour in the year.

In a Portland cement factory in Westphalia it has been found that of the 400 H.P. of the steam engine, 70 H.P. were used for driving shafting alone with no load, and since this factory is working day and night, we may say that during a year of 300 working days, $300 \times 24 \times 70 = 504{,}000$, or more than half a million horse-power-hours are wasted, which means at, say, ½d. per horse-power-hour, a sum of £1,050 per annum.

For driving a ventilator in a cement factory, 15 H.P. were transmitted a distance of 263 ft. Two shafts, a reducing gear and four belts were used, and exact measurements showed that 8·1 H.P. were absorbed by shafting and belts.

Since the ventilator had to work day and night, this small transmission caused a yearly loss of $8{\cdot}1 \times 24 \times 300$ (working days per annum) = 58,320 H.P.-hours.

It has been found that belts of $\frac{1}{16}$ in. thickness, at a speed of about 20 ft. per second, and the usual pulley diameter waste about 2 lbs. per $\frac{3}{8}$ in. of belt width. Simple cast tooth gears work with an efficiency rarely over 90 per cent., and worm gears hardly ever attain an efficiency of 50 per cent.

If we take works driven by steam-power, we find that the losses in shafting alone are very considerable. In the case of a wagon works this was found to vary from 22 per cent. to 57 per cent., and in the case of an engine works it was found to vary from 25 per cent. to 70 per cent., the average being 42 per cent. At another engine works, where fairly long lines of shafting and comparatively a small number of tools were used, the loss was 75·6 per cent.

Given below in tabulated form are some particulars of the shafting losses in different works, from which it will be seen that the loss varies from 39 per cent. to 77 per cent. It is obvious that, other things being equal, the greater the average distances of the machine from the driving engine the greater is the loss in shafting.

Nature of work.	Total H.P.	Per cent. to drive shafting.	State of load.	H.P. per 100 ft. shafting.	H.P. per 100 lbs. shafting.	H.P. per bearing.	H.P. per belt.
Wire drawing and polishing ...	400	39	½	14	·58	·37	1·76
Steel stamping and polishing ...	74	77	½	9·8	·35	·84	2·4
Boiler and machine work	38	65	⅜	4·77	·21	·55	·48
Heavy machine work	112	57	1	5·7	·23	·58	·45
Light machine work	74	54	1	8	·4	·69	·12
Manufacture of small tools ...	47	52	1	2·5	·23	·24	·11
Do.	190	57	1	4·36	·43	·33	·21
Screw machines and screws	241	47	1	6·33	·38	·63	·23

(To be continued.)

Cromer.—An inquiry has been held by Major C. E. Norton, R.E., on behalf of the L.G.B., into the application of the U.D.C. to borrow £25,000 for the establishment of electric lighting works. Messrs. O'Gorman and Cozens-Hardy are the engineers. An agreement has been entered into with Messrs. Edmundson's Electricity Corporation to carry out the construction to the satisfaction of the Council's engineers. The Council can take over the works at seven, 10, or 14 years.

THE CONTROL OF ELECTRIC MOTORS IN FACTORIES.

By N. C. WOODFIN.

A DIFFICULTY that sometimes hinders the adoption of electric motors in factories, more than their first cost, is the ignorance of the non-electrical man of the facility with which they can be operated, or, rather, while he may partly see the advantages of direct power application and the saving of idle shafting with its continuous absorption of power, he may have a lurking suspicion that these advantages are counter-balanced by the addition of the many fittings and contrivances which he is told are necessary for the operations of starting, stopping and regulating the speed of the machine, and to prevent its being damaged by overload.

Though there are several fairly good starting switches on the market, they are all more or less expensive. How is it, therefore, that these have not yet reached that perfection which includes simplicity and cheapness, as well as absolute protection of the motor? Perhaps it is because the intimate relation of the switch to the motor has not always been kept in view, and it is questionable whether, from the point of view of obtaining a perfect adaptation of this important adjunct of electric driving to its work, it is desirable that motors and starting switches should remain the productions of separate manufacturers, seeing the amount of loss and extra expense that users suffer thereby.

Starting switches ought to have the whole of their working parts enclosed in suitable cast-iron boxes, affording protection from weather, and entirely preventing interference with any of the electrical conductors, only a strong simple lever being allowed to project from the box and operating a bar inside, which is securely attached to, but strongly insulated from, the electrical movable arm.

It is often the case that an insecure connection of the magnet wire of a shunt motor leads to a breakdown, because the relative importance of this wire is seldom understood by the user, and is sometimes not attended to by the wireman who connects up a machine.

When it is remembered that a motor of the shunt type must have at least three terminals, which are often exposed on the outside of an enclosed motor, and also that a starting switch for this must have five terminals (that is, providing for two-pole make-and-break of the circuit, which is eminently desirable), it is seen that with the switches mounted on an ordinary slate, with the resistances in a suitable cast-iron box behind or underneath as the case may be, there appears what may be readily regarded by the non-technical user as a complicated piece of apparatus (independently of the motor, itself curious enough) which is so objectionable in the yard or shops of a great industrial establishment, where many labourers and apprentices are employed. In order to simplify matters, therefore, it is suggested that starting switches as separate contrivances should be done away with in the ordinary applications of driving motors in factories, and the switch should be looked upon as part of

COMPARATIVE COST OF WORKING HYDRAULIC AND ELECTRIC LIFTS.

Type of lift.	Load.	Source of power.	Travel in feet.	Cost of average round trip up and down in pence.	Number of trips per penny.	Remarks.
Electric	7 cwt.	Manchester Corporation	50	·159	6·3	Observed. Conditions unfavourable. Current at 2½d.
Hyd. suspended H.P. ...	7 cwt.	Manchester Corporation	50	·29	3·45	Calculated from published scale.
Hyd. suspended L P. ...	7 cwt.	Manchester Corporation	50	·445	2·2	Calculated at 6d. per 1,000 gallons. Pressure, 50 lbs.
Electric	9 cwt.	Private supply	50	·066	15	Observed. Conditions ordinary. Current at 2½d.
Hyd. suspended H.P. ...	9 cwt.	London Hyd. Power Co.	50	·277	3·6	Calculated from published scale.
Electric	9 cwt.	Glasgow Corporation ...	50	·061	16·4	Observed. Current at 2½d.
Hyd. suspended H.P. ...	9 cwt.	Glasgow Corporation ...	50	·212	4·7	Calculated from published scale.
Hyd. suspended H P. ...	12 cwt.	London Hyd. Power Co.	50	·35	2·86	Observed.
Hyd. suspended H P. ...	9 cwt.	London Hyd. Power Co.	50	·287	3·5	Observed.
Hydraulic ram. H P. ...	12 cwt.	London Hyd. Power Co.	50	·42	2·4	Observed.

the motor itself, which it really is, since no motor is complete without it. In most enclosed motors it would not be difficult to provide space for the working parts of a starting switch, by suitably designing the cases or carcases to give room for this addition. When one considers the great advantages of having a motor with its starter complete in itself, ready to be directly attached to a pair of mains anywhere, one wonders that this plan is not more adopted. If you want to sell an article, make it as simple and easy as possible to the man who is to use it, and he is far more likely to take to it and buy more.

Among the points gained would be greater ease of installing and connecting up (only two connections to make), removing expense of starter box case and separate fixing and wiring of this, entirely doing away with the bother which arises when a man objects to pay 10 per cent. extra on the price of a motor to cover the starting switch, convenience of testing and running motors in stock and showrooms, the prevention of interference with magnet and armature connections, and the consequent simpler and more mechanical appearance of machines. One might even suggest, in order to further perfect the enclosed motor, the insertion of a spring-controlled cheap electro-magnetic or other ammeter, with a dial marked in horse-power, or merely with zero and quarter-load marks that would show what the motor was doing, and when it had reached its maximum. This addition would mean just another glazed hole at some convenient place in the case of the machine. Such an instrument as the Phœnix ammeter could be used; it need not be jewelled, and is sufficiently unaffected by other magnets close to it. The only two terminals that will be required for our complete motor on the outside of the case might be made in the form of a strong well-insulated bayonet joint, so that to instal and start a motor anywhere after cementing it down, or fixing it to the work it has to drive in any convenient way, all one would have to do would be to put in the plug (which should be capable of being easily and securely wired by an inexperienced person), push over the starting lever, and then the machine would begin running.

There must be between this plug fitting and the armature all the adjuncts of a complete starting switch, quick in action, compared with the time it would take to remove the plug; this must be made so as not to be too quickly taken out, nor easily interfered with, by putting it in a somewhat inaccessible position compared with the starting and controlling lever, which must, on the other hand, be placed in the very easiest position for working.

The very useful application of electricity to the driving of portable tools such as drills and saws and the like, demands, at any rate, the fixing of the starting switch to the motor or tool itself, and thus affords an illustration of the way in which such appliances could be made more facile and perfect through having a motor which is a complete design in itself, and not making the starter, even including automatic cut-out and no-load release, appear as an addition or afterthought.

Where series motors can be employed, and these are sometimes preferred for the above-mentioned tools, the system of making the starter part and parcel of the motor itself lends that arrangement to a readier adoption of series and parallel connections of the magnet coils, since no external multiplication of wires is entailed, and on this account some resistance wire may be saved. In various ways, therefore, economy is obtained.

Undoubtedly bad systems and switches for the control of motors have done much to hinder their more general adoption. It is not always easy to find a convenient place to fix a starting switch, nor to get machine men to use it in the best way. A considerable amount of time is lost in getting the tools started in an engineering shop where some such practice as the following has held:—The blowing of the whistle a minute or two before the hour for commencing work is the signal for the engine driver to open the steam valve of the direct connected set used for driving the shop, it may be five minutes or more that is required for the shunt generator to excite on no load; before this time is up, a number of men are shifting their starting switch levers, and not a few have set them for full on; full speed and E.M.F. of the generator have not yet been reached, and are further retarded, so that it is, perhaps, 10 minutes or a quarter past the hour before the machines are going at full speed. Moreover, it is found that where the closing hour is also the signal for shutting down the generator, workmen will leave their motors to be stopped in this way, and then any starting switch not fitted with a no-load release is left full on; the writer has seen cases where attempts have been made to start up under short-circuit in this way, with all the annoyance that that means in locating the switches.

Similar troubles, and the vagaries of workmen in operating starting switches, led the works manager of a place wrought by electric power to say that all the switches should be cleared out of the shop and brought into the engine house. The equivalent of this was done, and a new system of control of the motors devised, by which the actual starting and stopping was taken out of the hands of the men, and was done by the engine driver or switchboard attendant. This plan has now been in use for upwards of two years with much satisfaction. Electric bell pushes were placed beside the machine tools and connected up to an indicator board in the engine room, so that the attendant could start or stop any machine as the men desired. Moreover, one starting switch fitted with an extra lever and an extra set of contacts is used for all the motors, and the cost of this slightly more complicated universal motor-starting switch, as it is called, is probably not more than half the total cost of fitting a starting switch to each machine. This switch has been designed to control two dozen motors, but could very easily be designed for more. Single-pole switches are used to short-circuit the starter when a motor is full on, and are placed on a switchboard in front of the universal starter, having an ammeter on each motor.

The cut-outs on the board protect the cables and motor at the same time. In this system of motor control it will be seen that the starting switch may be operated by a technical hand with instruments to guide him, the result being that the switch is used in the best way, and the whole generator load kept under better control. Of course, electric cranes cannot be worked in this way from the station, but these, again, should be operated by one experienced in the use of starting-switches. Three-motor cranes are often fitted with a small switchboard, with cut-outs and an ammeter thereon.

An objection may be raised that one motor after another has to wait till the universal starter has done its rounds, but the chances are that this is counter-balanced by the increased speed with which all motors are started—quickly following one another, yet not all at once.

MR. SWINBURNE ON PATENT LAW.

Mr. James Swinburne, President of the Institution of Electrical Engineers, puts forward some highly original and amusing views on patents and patent laws in two articles in *Page's Magazine*. It is doubtful from the tone of the articles whether some of the startling conclusions arrived at by Mr. Swinburne are meant to be taken seriously, but, as we know, the truth is often spoken in jest, and we shall assume that Mr. Swinburne considers that the results of his cogitations on this subject come within the sphere of practical politics.

In his article on "International Patent Monopolies," Mr. Swinburne comes to the conclusion that "it is clearly against the public interest in each country to allow foreigners to patent at all." If a country grants patents to foreigners, it wilfully, in Mr. Swinburne's opinion, deprives itself of all the advantages of other nations' experience. If it grants foreign patents, and allows foreigners to manufacture abroad and import the patented articles, it wilfully deprives its own people of the chance of making these articles, and makes them buy them at an enhanced value from other countries. If it does not allow the importation of the foreign patented article, and insists on the patented article being made at home, its own workmen will be employed, but the public will have to pay extra.

If this is a complete statement of the case, it becomes necessary to explain why so many of the most civilised nations are so blind to their own interests as to grant patents to

foreigners. Mr. Swinburne quite recognises that the policy of modern States is not altruistic, but he finds sufficient explanation for their eccentric behaviour in the matter of foreign patents in the desire of politicians to raise taxes from the fees of foreign patentees, and thus avoid giving offence to their constituents by taxing them. But can this be seriously urged? If the total Patent Office surplus in this country were abolished by reducing the fees, the relief to the taxpayer would be infinitesimal, and only a small fraction of the surplus is derived from foreign patentees. It is inconceivable that nations like Germany and the United States, which are so strongly protectionist, should admit foreigners to the privileges of their patent law merely for a few tens of thousands of pounds which the fees add to their revenue. The real reason for granting patents to foreigners is that the foreign patent encourages the early introduction of the invention into the country where the patent is granted. An invention in its infancy requires the expenditure of a considerable amount of capital before it begins to be profitable. If there is no patent monopoly, no manufacturer will take up the invention, the result being that a country which does not grant patents to foreigners will always be several years behind in the introduction of a manufacture invented abroad. In any country where there is a constant lag of five or 10 years in the introduction of labour-saving inventions, the national wealth will always be considerably less than it possibly might have been. When a patent was refused to Bessemer by the Prussian Patent Office for his process of manufacturing steel, petitions were actually presented by Prussian manufacturers that a patent might be granted so that it should be possible for some one manufacturer to take up the invention free from risk of ruinous competition from other manufacturers.

Mr. Swinburne's views on the official examination of inventions in his article on "Examination of Patent Specifications" appear to us to be equally one-sided and misleading. Evidently he considers that if the State examines inventions for novelty with power of rejection, the State should guarantee the validity of the patents which it grants. In no country where the examination of patents with power of rejection is in force does the State guarantee the validity of patents passed by the Patent Office, Mr. Swinburne says the State protects the patentee in Germany, but in this we think he will find he is mistaken. Patents may be challenged in the Law Courts after they have been passed by the Patent Office in Germany as well as in the United States.

Mr. Swinburne brings forward a very old, and, we think, a very weak, argument against the official examination of patents. He says "the broad difficulty is that it would involve waste of time and money, for each of a number of patents, of which most will never be of any value, will have to be examined in great detail. If it does not pay each patentee to examine his specifications in this careful way, it can hardly be policy for the State to do so." To take an illustration, Mr. Swinburne's statement is equivalent to saying that it can hardly be policy on the part of a gold-miner to separate the sand from the gold dust because the nine grains of sand which he separates from each grain of gold are worth nothing. The labour which is expended is for the sake of the gold which is kept, and not for the sake of the sand which is rejected. Again and again has this short-sighted objection been raised by the opponents of the official examination of inventions. They can only see that public time and money is expended on examining patents which are worthless; they fail altogether to perceive that this examination and rejection of worthless patents immensely enhances the value of the good patents which are passed.

In comparing the policy of the State with the interest of the inventor who applies for a patent, Mr. Swinburne again shows that his opinions on this question are very superficial. The interest of the State in granting a patent is by no means identical with the interest of the applicant for a patent. As a matter of fact, they are usually quite different. The duty of the State in granting a patent is, while it encourages genuine invention, to make certain at the same time that industry is not hampered, and that consumers are not blackmailed, by bogus patentees. The interest of the applicant for a patent is, in the great majority of cases, to get his patent, whether it is a bogus patent or not. It is, in view of this, decidedly weak for Mr. Swinburne to tell us that, because the multi-patentee does not find it worth while to test the novelty of all his own inventions before he applies for a patent, it must be bad policy for the State to examine all inventions, the bad as well as the good.

Another objection raised by Mr. Swinburne to official examination is that the examiner, even if skilled technologists were employed in that capacity, could not, in the short time at his disposal, decide cases of infringement which can only, under the present system, be settled in the Law Courts by the expenditure of much time and money to secure the best legal and expert assistance. It may be admitted that the examiner could not possibly take the place of the Law Courts in settling these difficult and doubtful cases. But the examiner is not likely to be called upon to decide on the rejection of inventions that come into this category. Official examiners, especially in this country, where so much deference is paid to the rights of the individual, will be instructed to give doubtful cases the benefit of the doubt, and only reject on clear cases of anticipation. That it is so in Germany and the United States, where effective examination by the State is at present in force, is shown by the fact that in these countries almost as great a percentage of patent cases come before the Law Courts as in this country, where there is no examination. The introduction of effective examination of patents in this country is not likely, therefore, to reduce the number of patent cases which come before the Law Courts, and the fear of this result, which has been suggested as an explanation of the almost universal opposition of patent barristers and scientific experts to this amendment of the Patent Law, is probably groundless.

Though effective official examination, that is, examination with power to reject on clear cases of anticipation, may not reduce the number of doubtful and difficult cases which appear before the Law Courts; nevertheless, we believe it would confer immense benefits on the *bonâ fide* inventor by increasing the value and saleability of his patents, and on manufacturers by ridding them of vexatious demands for royalties on patents which they know very well to be invalid, but which they do not care to go to the trouble and expense of contesting.

The system of examination without power of rejection which is embodied in the Bill at present before Parliament, and which receives the approval of Mr. Swinburne, lacks the essential justification for any system of official examination, namely, the power of suppressing bogus patents. The Bill as it stands merely proposes to do patent agents' work for the inventor at a cheap rate, practically without asking him to pay any more than he does at present, which happens to be more than is necessary to pay office expenses. This, of course, is an excellent thing for the inventor when it is not considered to be good for him to have his patent fees further reduced, but what about the morality of the State in thus spending public money to benefit a class, and to compete with a struggling profession?

NEW PATENTS, 1902.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

19,109. "An improved chain for suspending electroliers." I. Clements and C. Clements. September 1st.

19,110. "Improvements in electric arc lamps." F. J. Green. September 1st.

1,9112. "Improvements in or connected with electric railways and tramways on the stud contact system." G. Wilkinson. September 1st.

19,128. "An improved electric heater or 'radiator.'" E. G. Rivers. September 1st.

19,172. "Improvements in or relating to devices for operating trolley arms." E. Limauge. September 1st.

19,180. "Improvements in electric baths." J. Zwiebel. September 1st. (Complete.)

19,208. "Improvements in or relating to trolleys for electric traction." S. Roberts. September 2nd.

19,272. "Improvements in incandescent electric lamps." A. W. W. Miller. September 2nd. (Complete.)

19,282. "Improvements in electric transmission and controlling gear." J. Johnston and A. E. Dobbs. September 2nd.

19,291. "Improvements in electric burglar and like alarms." H. J. Haddan. (The firm of Töpffer & Schädel, Germany.) September 2nd. (Complete.)

19,305. "An improved apparatus or device for use in applying bituminous or similar composition to conduits for electric cables, or to drain pipes, or like goods to form jointing rings thereon." W. Oates. September 3rd.

19,361. "Improvements connected with elevators or lifts." Otis Elevator Company, Limited. (Otis Elevator Company, Incorporated, United States.) September 3rd.

19,366. "Improvements in or relating to electric cable conductors." W. E. Hitch. September 3rd.

19,368. "Improvements in electrodes." J. Hargreaves. September 4th.

19,377. "An improved form of electrical choking coil." F. J. Green. September 4th.

19,420. "An improvement in electric switches." O. Imbay. (Sprague Electric Company, United States.) September 4th. (Complete.)

19,432. "Improvements in electric switches with automatic electro-magnetic release." G. W. Green and R. Poole. September 4th.

19,492. "A combined pull down fitting and universal shade fitter for general electric lighting purposes." R. B. Braham. September 4th.

19,483. "Apparatus for teaching wireless telegraphy." L. Angel. September 5th. (Complete.)

19,488. "An improved electrolytic electricity meter." J. B. y Hernandez, E. M. y Mujia, L. de la Pena and J. B. y Ortega. September 5th. (Complete.)

19,529. "An electrical ignition device suitable for petrol motors and the like." J. H. Clarke. September 6th.

19,553. "Improvements in and relating to electrical switch devices, applicable to rheostats, commutators, and the like." H. H. Lake. (General Electric Company, United States.) September 6th.

19,564. "Improvements in electrical switches." H. H. Lake. (General Electric Company, United States.) September 6th.

19,565. "Improved method of manufacturing insulating bushings." H. H. Lake. (General Electric Company, United States.) September 6th.

19,566. "Improvements in and relating to electric switch regulators." H. H. Lake. (General Electric Company, United States.) September 6th.

19,567. "Improvements in trolley wheels." H. H. Lake. (General Electric Company, United States.) September 6th.

19,568. "Improvements in and relating to the cooling of electric motors." H. H. Lake. (General Electric Company, United States.) September 6th.

19,571. "Improvements in systems of electrical distribution." H. H. Lake. (General Electric Company, United States.) September 6th.

19,572. "Improvements in trolley wheels." H. H. Lake. (General Electric Company, United States.) September 6th.

19,573. "Improvements in and connected with contact-shoes for electric railways." H. H. Lake. (General Electric Company, United States.) September 6th.

19,579. "Process and apparatus for the detection of short-circuits in electric batteries." H. Beckmann. September 6th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1902.

12,762. "Improvements in and relating to water-heaters." A. E. and A. W Greville. Dated July 14th, 1900. In an electric water-heater or geyser the water from the supply pipe is distributed on to a metal plate through a basket and flows down the electric conductors which are heated to a plate and to the bottom of the heater and the outlet. 2 claims.

12,827. "Improvements in electrical switches." E. E. Bartlett and J. E. Robinson. Dated July 17th, 1900. In order temporarily to hold the switch "on," a spring-controlled ball or bolt is fitted in a recess in one of the contacts and is adapted to enter a recess in the other contact. 1 claim.

12,846. "Improvements in portable electrical safety lamps." J. Glassmachers and C. Muller. Dated July 17th, 1900. Miners' or safety lamps. A portable secondary battery lamp is constructed as described. The electrodes are perforated lead tubes filled with oxide paste and are contained in two metal cases with screw covers lined with vulcanite or other non-conductor. The cases are connected by tubes on a glass cylinder enclosing an incandescent lamp. Wires passed behind the linings and through the tubes connect the cells to the lamp and a switch, and to charging terminals. 3 claims.

12,855. "Improvements relating to the manufacture of bulbs for electric incandescent lamps." C. Junge. (Oberlausitzer Glashuttenwerke Otto Hirsch; C. L. Weisslvasser.) Dated July 17th, 1900. Bulbs are entirely closed in manufacture before being allowed to cool by pressing together the end of the necks, fusing on stoppers, or moulding, to prevent access of dirt or gases to the inner surfaces. 1 claim.

12,874. "Improvements in and relating to telephonic apparatus." G. Bianek. Dated July 17th, 1900. Relates to the employment of a number of microphones in separate primary circuits of an induction coil having only one secondary. 9 claims.

12,876. "An improved trolley for overhead electric traction." E. C. Johnson and F. D. Palmer and C. Coonan. Dated July 17th, 1900. A tubular shaft runs on ball bearings on a spindle fixed in a forked head. The trolley wheel is free to turn and slide on the shaft, and is kept central by springs. 2 claims.

12,893. "Underground wires and accessories for transmitting electric energy." F. Rossi. Dated July 17th, 1900. Relates to the laying and taking of branches from single or concentric underground conductors applicable for use in electric tramways. 9 claims.

12,944. "An improved electrical switch." H. F. Clayton, T. Bell and S. S. Berry. Dated July 18th, 1900. The contact arms are carried by a boss having flattened sides and fitted on a central pin. The handle fits loosely on the pin and embraces the arms. A spring-controlled pin sliding in a recess in the base serves to give a quick break. 2 claims.

12,950. "Improvements in apparatus for the electrolysis of water." P. Garuti and R. Pompilio. Dated July 18th, 1900. Oxygen and hydrogen obtaining. Relates to the apparatus described in Specification No. 23,668, A.D. 1896, for electrolysing water. 8 claims.

13,014. "Improvements in or connected with fuses or cut-outs for high voltage circuits." H. Oppenheimer. (Actiengesellschaft Mix & Genest.) Dated July 19th, 1900. In order to prevent arcing when a fuse blows, an auxiliary path is provided consisting of a film of metallic paint. In addition to the ordinary fuse, wires are led to the cover, which may be made of insulating material and formed with a deep groove. The bottom of the groove is painted with a metallic paint. 2 claims.

13,015. "Improvements in and connected with insulated bases for switches." H. Oppenheimer. (Actiengesellschaft Mix & Genest.) Dated July 19th, 1900. Relates to a base adapted for high voltages. A base for a double-pole switch is described. Four cavities are formed for the reception of the conductors which are connected to the terminals let into recesses. A rim is formed to prevent leakage, the switching mechanism being fitted in a recess. 1 claim.

13,020. "Apparatus for generating dynamical electricity by means of the direct influence of steam." E. Hansen. Dated July 19th, 1900. A steam supply pipe is insulated at the joints and connected to a drum formed with a number of radial outlets, pipes provided with orifices arranged in a zig zag or like fashion. A collector plate with pin-like projections is placed opposite the steam orifices and connected to a primary winding which is also connected to the insulated part of the steam pipe, and provided with a spark space. A secondary winding is provided as usual. 1 claim.

13,030. "Improvements in portable machines for grinding, drilling or analogous purposes." H. P. Brown. Dated July 19th, 1900. A machine for grinding, drilling, &c., is made portable for operating on the rail joints of electric railways and tramways *in situ*. The frame is preferably made with metal ends connected by wooden side rails. Handles are clamped in lugs and legs in sockets. A shaft is driven by gearing and a crank handle. A flexible shaft is attached to the shaft which carries a fly-wheel. 4 claims.

12,971. "Improvements in electric switches." D. R. Gunn. Dated July 19th, 1900. Relates to switches with a fly movement, adapted for general use or for a lampholder. A wall switch with a circuit open and a lampholder with the circuit closed is described. 2 claims.

12,972. "Automatic booster in connection with multiple wire system." J. S. Highfield. Dated July 19th, 1900. In order to keep the pressure constant in systems in which storage batteries are employed, and also to raise the bus-bar pressure to charge the batteries, a booster is arranged between the batteries and the wires. 1 claim.

12,973. "An indicator for high electric tensions." Siemens Bros. & Co. (Siemens & Halske Aktiengesellschaft, Germany.) Dated July 19th, 1900. An indicator for high electric pressures, consists of a metal disc and surrounding ring, one stationary and the other carried by an axle, which also carries a non-conducting pointer over a stationary scale and is controlled by a spring, either the movable part or both having tangentially directed points. The disc and ring are oppositely electrified, and the movable part is turned by the action of electrified air streaming from the points. An insulating ring may be placed between the parts. A weight may be used instead of the spring and a notched flat ring instead of the circumferentially pointed disc. The disc may be allowed to rotate and connected to a counter. Variation of frequency of alternating pressures may be compensated by use of condensers and impedance coils in connection with the indicator. 2 claims.

12,977. "Improved electric battery." P. E. Fransson. Dated July 19th, 1900. A constant battery of rectangular throughout, with two cells in one outer vessel, comprises zinc plates immersed in diluted sulphuric acid of 15° Bé contained in terra cotta or earthenware porous vessels, and special carbon poles immersed in sodium-bichromate solution of 30° Bé. The carbon poles consist of a number of thin plates retained in lead sockets, and electrolytically coated at the ends with copper, and electrically, or otherwise, with a precious metal. The zinc plates are held centrally in the vessels by passing through ebonite cross-pieces, retained by terminal screws. 2 claims.

13,036. "Improvements in dynamo-electric machines and electric motors." H. T. Jost. Dated July 19th, 1900. Relates to the construction of dynamos and motors, in which the field magnet is provided with a single exciting coil, and the frame or casing forms part of the magnetic circuit. 10 claims.

13,044. "An improvement in electric railways in which transformers are carried on the train." Siemens Bros. & Co. (Siemens & Halske Aktiengesellschaft.) Dated July 19th, 1900. When transformers are carried on the train, working current is supplied to the motors, or to some of them, from the transformers alone when the train is running on the level track, and from stationary generators alone, or from stationary generators and transformers together, when the train is starting or running on an incline. 1 claim.

13,048. "Improvements in and relating to means for controlling the speed of electric motors." W. B. Elliott and J. W. Eskholme. Dated July 19th, 1900. Relates to means for controlling the speed of electric motors, particularly in the operation of printing machines, whereby the motor may be started at an extremely low speed with great torque, and the speed gradually increased without jerks, preferably by means of a single-handed lever. To obtain the necessary starting torque while avoiding the danger of sparking at full speed, the motor has two separate armature windings, which are connected in series when starting the machine, and thrown into parallel before the machine reaches its full speed. 38 claims.

13,081. "Improvements in means for grinding and truing-up dynamo commutators and the like." P. J. Purdy. Dated July 20th, 1900. Relates to means for grinding and truing-up dynamo commutators and other objects, *e.g.*, the bowls or printing rolls of calico and like printing machines, *in situ*. The work is performed either by a grinding wheel, driven from the commutator or other rotating part of the machine, or by a turning tool. 5 claims.

13,085. "Improvements in the methods of and means for sounding alarums on electric tram and motor cars." A. R. Durante and A. Pariotto. Dated July 20th, 1900. Relates to alarms for electric tramcars and motorcars. The bell, gong, whistle horn, syren, or other alarm, is actuated by a separate electric motor, the circuit of which is completed by the driver by means of an electric button or switch on the brake, or controlling handle, this arrangement enabling the driver to sound the alarm without removing his hand from the handle. When a whistle horn, or other similar alarm is employed, it is sounded by compressed air supplied by a suitable pump driven by the motor. In the case of bells, or gongs, the motor actuates the hammer by means of a tapper. 2 claims.

13,095. "Storage battery electrode." R. MacRae and H. C. MacRae. Dated July 20th, 1900. Each electrode is built up of a series of slate or plates separated from each other by narrow spacing frames, or by upturned flanges on the plates themselves. A pile of these plates is then united together by fusing and soldering on them solid vertical edge-pieces in which a core of conducting wires is embedded. The elements thus formed then has a longitudinal groove cut along its edges, and pieces of a sufficient height for forming an electrode are cut off from it and assembled together, lead-covered wires being used to fill the spaces formed by adjacent grooves. When the parts are in position they are soldered together, and lead plates are soldered to the top and bottom of the electrode. 7 claims.

13,106. "Improvements in safety devices for electric interlocking or block signalling apparatus." J. J. Hollies. Dated July 20th, 1900. Relates to means for preventing electric interlocking or block signalling apparatus from being effected by stray earth currents. 1 claim.

13,134. "Improvements in and relating to electric arc lamps." A. E. Walton. Dated July 20th, 1900. Relates to electric arc-lamps and transformers. 6 claims.

13,159. "Improvements in electric traction with surface contacts." E. Cravellier. Dated July 21st, 1900. Relates to electric railways and tramways with direct or three-phase or other currents and on a road contact system with switches operated by magnets on the vehicle. 5 claims.

13,286. "Improvements in arc lamps." J. F. Ackermann. Dated July 22nd, 1900. Arc lamps, especially for lighthouse and searchlight use. Powdered arc lamp carbon or magnesium, or other material to give coloured light, is fed to an arc between carbon or other electrodes, through a perforation in the upper electrode, from an open receptacle by an injector supplied with compressed air through a side tube. The end of the lower electrode is recessed. Regulating valves are provided on the air and powder supply tubes. The electrodes may be movable by any suitable means, to strike and regulate the arc. 8 claims.

13,356. "Improvements in telephonic repeaters." W. P. Thompson. (Communicated.) Dated July 24th, 1900. A repeater for telephone systems is constructed with a microphone mounted between the poles of two electro-magnets, and having the magnet armatures on the diaphragms. The magnet coils are connected to line circuits including secondaries of the induction coils. The primaries of the induction coils are in a local circuit including the battery and the microphone. The repeater may be arranged as a booster across two through circuits. Two or more microphones and magnets may be employed; in one form, the microphones are mounted in adjustable spring rings, the opposite sides of each of the microphones being connected to two armed yoke pieces carrying at their ends the armatures of the magnets. The yokes are supported by springs, and the microphones and rings are provided with adjusting screws. The microphone may be rotatably mounted. When magneto transmitters are employed, low-resistance secondaries must be used in the induction coils. 6 claims.